The Dock & Harbour Authority

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Every harbour—be it in an arctic, a temperate or a tropical climate has its own special dredging problems.

We are proud of the fact that, since the inception of the Priestman system of Grab Dredging more than 75 years ago, the wide experience which they have accumulated has, on numerous occasions, proved of assistance to Harbour Authorities and many dredging problems have this way been solved. As a result of this service more than 300 of the World's Ports have purchased Priestman dredgers.

Singapore Harbour Board.

For dredging works around the quays of Singapore the Harbour Board use two Priestman dredgers. These were part of a substantial fleet built for the Ministry of Transport and are of the pontoon type being fitted with Priestman No. 50 size ($2\frac{1}{2}$ cubic yard) steam driven dredging cranes for handling silt, sand and debris. Some of the latter is shown on the right of the photograph. A grab dredger can more easily handle this class of material than can any other type.

Public Works Department, Singapore.

This Authority, which is responsible for certain dredging works in Singapore, operates the grab dredger "Eddy" which they ordered in 1949. This dredger has to comply with certain very stringent dimensional limitations including a limited headroom of 10-ft. 0-in. above water level.

The No. 50 size ($2\frac{1}{2}$ cubic yard) Priestman grab dredging crane is fitted with a 42-ft. 0-in. long jib suitable for operating at 26-ft. 0-in. or 40-ft. 0-in. radius. At the shorter radius a 70 cubic feet capacity "Mud" type grab is operated whilst at 40-ft. 0-in. radius the grab capacity is 40 cubic feet. Arrangements are also provided for the propulsion of the vessel by means of the crane engine when working in still water over short distances.

This dredger regularly handles 900 to 1,000 cubic yards of spoil in less than seven hours dredging time.

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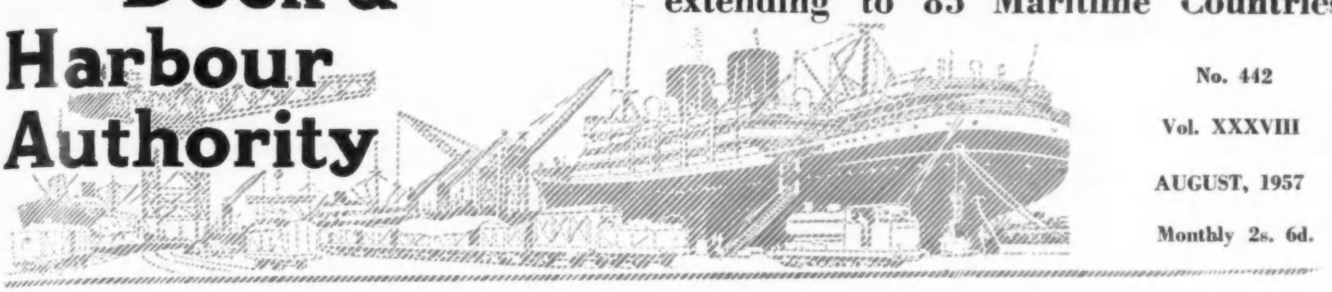


Editorial Comments

The Port of Newport.

Continuing our review of the ports of South Wales, we are publishing this month, through the courtesy of the Chief Docks Manager, South Wales Docks, an account of the history and development of the Port of Newport.

Newport was a town of comparatively small significance until the early years of the nineteenth century, and its growth, and the construction of a modern port, was chiefly due to the expansion of the rich coal fields in Monmouthshire and the subsequent development of heavy industries, notably iron and steel.

Until recent years the prosperity of the port largely depended upon the export of coal, which totalled millions of tons a year. Since the Second World War, however, owing to increased demands for home consumption, the volume of coal exports from the United Kingdom has declined appreciably and Newport, in common with her sister ports in South Wales, has suffered a serious recession. As is pointed out in our leading article, however, in addition to the quays used exclusively for the bulk handling of coal, the lay-out of the port was originally planned to also provide separate quays with their ancillary equipment for the handling of general cargoes, both import and export.

As the result of this foresighted policy, Newport is more resilient to changing patterns in trade and it is significant that, during recent years, there has been an increase in general exports and a marked increase in the import of iron ore, tin and other raw materials. These developments are encouraging and will be facilitated by the extensive modernisation schemes which are at present being undertaken by the British Transport Commission and by private companies.

Dock Labour in Rotterdam.

Schemes to decasualise dock labour are always being discussed; that recently introduced in Rotterdam is one of the important ones. On page 127 of this issue, Mr. R. Laan, Jr., the President of the Dock Workers' Section of the Dutch Transport Workers' Union, reviews the present position of dock labour in Rotterdam and gives interesting details of both the decasualisation and training schemes which are now operating there.

The port has some 14,000 workers, of which 9,000 are in permanent service. Nevertheless, neither the employers nor the union officials are yet satisfied and both sides of the industry still aim to decrease intermittent employment. All workers, permanent and "pool" (Labour Provision Service) are entitled to the same holidays and sick and accident pay and also to a retirement pension.

The Union plays a positive role in the training scheme. There is basic training, the training of specialists, such as fork truck drivers, and the training of foremen. There is also a dock labour school which takes boys as they leave primary school.

Both decasualisation and training aim to produce skilled workers, to get the dockers recognised as such and thus to give them a greater sense of responsibility in their work. Mr. Laan states that much of this has been achieved and that the docker has now learned to consider himself an essential part of the operation of the port. There is no doubt that in all decasualisation experiments, positive steps should be taken to ensure that all workers, but particularly those whose employment is intermittent, should feel that they have roots in the industry and also that they owe something to it.

The XIXth P.I.A.N.C. Congress.

The XIXth Congress of the Permanent International Association of Navigation Congresses, which was held in London on the 8th to 16th July, will undoubtedly rank among the most successful congresses held under the aegis of the Association. It owed its success to many factors, among them the thorough and imaginative planning of the British Organising Committee, the carefully selected topics considered, the authoritative and informative papers submitted by authors from many countries, the splendid and fitting locale made available by the courtesy of the Institution of Civil Engineers and the inspiring opening address by the Congress patron, H.R.H. the Duke of Edinburgh. Some 1,000 delegates attended from over forty countries and, apart from the discussion sessions, there were numerous technical visits and excursions to places of historic, cultural and aesthetic interest. These, and the several enjoyable congress functions, were invaluable in stimulating cordial and rewarding intercourse between delegates of different countries and reflect the greatest credit on the very hard-working committees who were responsible for their organisation.

It says much for the extremely efficient manner with which the Chairmen conducted the meetings that the very heavy agenda was successfully completed with due deliberation and with the drawing up of thoughtful conclusions and recommendations. The arrangement for simultaneous translation into French and English undoubtedly contributed to this. A review of the technical meetings is given on a following page.

Japanese Pneumatic Breakwater Experiments.

The subject of pneumatic breakwaters, which has frequently been referred to in past issues of this Journal, is still receiving serious study in many countries and especially in Japan, where a second full-scale test was recently conducted (Winter 1955/6) under Professor Kurihara at Hajima Island. On page 137 of this issue will be found abstracts from Bulletin No. 9 of the Research Institute for Applied Mechanics, Kyushu University, which give an account of this further series of studies with some theoretical discussion.

In his report Professor Kurihara points out that in addition to the horizontal current set up by the vertical current rising with the bubbles, there is also some turbulence at the junction between the vertical and the horizontal current. He further points out, and illustrates his observation mathematically, that the relative importance (for wave stopping) of the horizontal current and this turbulent area depends upon the depth of the perforated pipe. Within limits, the deeper the pipe is placed the more important, in relation to the horizontal current, does the turbulence become. The effect of this change and the rate at which it occurs are apparently not yet established.

From the practical aspect, there does not appear to be anything in this series of experiments which contradicts the views expressed by many hydraulic engineers and scientists that the pneumatic breakwater is likely to be economic only with the shorter waves.

Topical Notes

The Association of Public Health Inspectors.

More than 1,700 delegates appointed by over 1,000 local authorities in England, Wales, Scotland, Northern Ireland and Eire will attend the 64th Annual Conference of the Association of Public Health Inspectors which will be held in Eastbourne from 17th to 20th September next. In addition, there will be representatives of a number of Government departments, overseas territories and other interested organisations.

The Papers for discussion cover a wide range of subjects connected with the work of the public health inspector and will include a symposium of three papers relating to the work of Port Health Authorities.

The Mayor of Eastbourne will entertain the delegates at receptions in the Winter Gardens on the evenings of Monday and Tuesday, 16th and 17th September and will welcome the delegates officially at the opening session of the Conference. Various excursions and visits have also been planned.

Extensive Use of South African Dry Docks.

The extensive dry docking facilities available at South African harbours were almost fully employed during 1956 when 336 vessels of various tonnages were accommodated. At Table Bay the largest tanker in the world, the "Universe Leader," 855-ft. long with a beam of 125-ft. and a deadweight tonnage of 83,900 was safely accommodated in the Sturrock Graving Dock. At Durban, the Prince Edward Graving Dock accommodated its largest ship in nine years when the "Athlone Castle," 725-ft. in length and 25.567 d.w.t. went in for cleaning and painting. At Durban harbour the floating dock and the Prince Edward Graving Dock gave dry docking facilities to 70 large and 97 small commercial vessels, 42 departmental and 10 naval vessels. The Princess Elizabeth Graving Dock, East London, accommodated one large commercial and 14 departmental vessels and the two Cape Town graving docks handled a total of 98 vessels.

International Society of Soil Mechanics and Foundation Engineering.

The Fourth Conference of the International Society of Soil Mechanics and Foundation Engineering is being held at the Institution of Civil Engineers, London, S.W.1, from the 12th to the 24th August, 1957. In addition to the nine Technical Sessions at which papers will be discussed, there is an exhibition of soil mechanics and foundation engineering apparatus, models illustrating actual work in progress at sites throughout the world and other demonstrations of interest to engineers.

The 176 papers have been preprinted in two volumes of Proceedings and are grouped in the following subjects:—

Soil properties and their measurement;
Techniques of field measurement and sampling;
Foundations of structures: general subjects and foundations other than piled foundations;
Foundations of structures: Piling and piled foundations;
Roads, runways, and rail-tracks;
Earth pressures on structures and tunnels;
Earth dams, slopes, and open excavations.

The Society was founded in 1936 and its Constitution is a federal one, membership of the International Society being confined to National Societies. Engineers interested in the development of soil mechanics and foundation engineering in any country are encouraged to form a National Society which, subject to certain conditions, may become a member of the International Society. From 1936 until 1953, the headquarters of the Society was at the Massachusetts Institute of Technology, after which it was transferred to London.

This Fourth Conference was formally opened by Sir Arthur Whitaker, K.C.B., President of the Institution of Civil Engineers, on Monday, August 12th, 1957, and is being attended by 1,200 members and interested engineers from 41 countries. The President of the Society and the Conference is Professor Karl Terzaghi, Professor of the Practice of Civil Engineering at Harvard University, and the Organising Committee is under the chairmanship of Dr. W. H. Glanville, Director of the Road Research Laboratory. The previous Conferences set a very high standard and were enabled to do so by financial assistance from Government and local authorities. This method of financing, however, was found impracticable in this country, but the Organising Committee has received generous support from consulting engineers, civil engineering contractors and various other bodies.

In conjunction with the technical sessions, visits have been arranged to eight laboratories in the London area and, after the Conference has been concluded in London, there will be four-day tours of East Anglia and Scotland to visit works of interest in those areas. Provision has also been made for a full programme of social events for all members and their ladies taking part in the Conference.

New Deepwater Oil Terminal for Venezuela.

It has recently been announced that plans are under consideration for a new deepwater oil terminal at Punta Gorda, which is situated on the east coast of the entrance to Lake Maracaibo, some nine miles north east of the city of Maracaibo, Venezuela. The terminal will be for the collection, storage and shipping of crude oil produced from the oil fields on the east shore of the Lake and in the Lake itself and will be constructed by the Shell Petroleum Company, Ltd. It is estimated that the project will be completed in two years and will cost approximately £30 million.

The terminal, which will be equipped with the most modern handling and control facilities, will have an initial throughput capacity of about 700,000 barrels of oil per day with a storage capacity of four million barrels. The port will be able to accommodate the largest tankers and will be capable of future expansion if required. Crude oil produced by the Company in the Lake Maracaibo area at present totals some 900,000 barrels per day, which is about one-third of Venezuela's current total production. It is intended that almost all of this output shall be handled either through the Punta Gorda terminal or through the light oil pipeline running from Palmarejo, on the west coast of Lake Maracaibo some eleven miles north of Maracaibo, to Cardon refinery on Paraguana Peninsula.

Mechanisation of Yugoslav Ports.

More mechanical equipment is being installed in Yugoslav ports in order to speed up loading. A total of seventeen 5-ton cranes will be installed at the ports of Sibenik, Split, Ploce, Dubrovnik and Bar and eight 3-ton cranes will be fitted at Rijeka. Delivery of the cranes will start this year. By the end of 1959, delivery is expected of five gantry cranes for the ports of Sibenik, Split and Ploce, for which $750,000 has already been appropriated, while an expenditure of $646,000 has been approved for the purchase of mobile cranes and trucks from Italy and Czechoslovakia. In the meantime, a floating crane with a capacity of 100 tons is now available at Rijeka. The crane is 42.19 metres long, 19 metres wide and has a draught of 2.45 metres. It has a range of 35 metres and will facilitate the handling of heavy lifts.

Milford Haven Developments.

Preliminary work has now begun on the new crude oil tanker terminal which is to be built for the British Petroleum Company at Popton Point on the south shore of the harbour of Milford Haven. Permission to proceed with the project was recently granted the Company with the passing of an Act by Parliament, and involves the building of a jetty, the erection of a tank farm and the laying of a 60 mile pipeline to connect the terminal with the BP refinery at Llandarcy.

Eight storage tanks are to be installed initially, each of which will be capable of holding 20,000 tons of crude oil, and work has begun on preparing the 220 acres of land on which they will stand. Tenders have been invited for the construction of the jetty, which will be of the usual T-head design with the pier extending 1,350-ft. from the shore and with a pierhead 2,300-ft. in length. It will be possible to accommodate simultaneously two of the largest tankers at this pierhead, at which there will be a depth at L.W.O.S.T. of 55-ft. At Popton Point five tanks to hold bunker oil and fresh water will also be erected, and administration offices, a fire station and canteens will be provided.

Every care is being taken in the planning stage to preserve the present amenities of the area and it is envisaged that much of the land purchased by the company will continue to be used for agriculture.

The Ports of South Wales

3. The History and Development of Newport

(Specially Contributed)

THE Town of Newport, which is the administrative and commercial centre of the County of Monmouth, straddles the River Usk near its confluence with the Bristol Channel, and is the hub of a network of rail and road communications linking South Wales with other industrial areas of Great Britain. The dock system is located just to the south of the town, at the mouth of the River Usk, and forms the easternmost of the chain of South Wales Ports administered by the Docks Board of Management of the British Transport Commission. The Newport Harbour Commissioners are the Harbour Authority for Newport; they are responsible for the lower reaches of the Usk and its estuary, and—jointly with the British Transport Commission—for the maintenance of the entrance channel leading to the docks.

In the course of its history the town appears to have been known by various names. Novas Burgas—the new town or burgh—seems to have been one, and Castell Newydd — the new castle — was another, the object, presumably, being to distinguish the locality from the old Roman Town and Port of Caerleon, a few miles further up the River Usk. Whatever the name may have been, its geographical position must have assured a strategic importance of some magnitude during the turbulent middle ages, as is evidenced by the remains of what obviously was a strong castle on the west bank of the river, near the present town-centre. Although there is evidence that its roots go back to ancient times, Newport is a comparatively young town, for it was not until the early part of the 19th century that its career as an important industrial centre and sea port really commenced and, over a comparatively short period, the population increased fivefold. The first stage in this development was the completion of the Monmouthshire Canal and Sirhowy Tram road. These two undertakings opened up access to the rich coalfields of the eastern and western valleys of Monmouthshire and greatly facilitated the conveyance of coal to Newport for shipment from the jetties and wharves located along the banks of the River Usk.

By 1830 the berthage accommodation in the river was proving inadequate to meet the requirements of a rapidly expanding export trade, and the urgent need for additional facilities provided the motive for the formation of the Newport Dock Company. In 1835 the Company obtained parliamentary powers for the construction of the first enclosed dock which was four acres in extent and opened in 1842, but the increasing demands of shipping continued swiftly to outpace the facilities offering and, before long even the new dock was heavily congested with vessels seeking a loading berth. Further parliamentary powers were obtained and in 1858 a $7\frac{1}{2}$ acre extension was opened; the new dock then became known as the Town Dock. In the meantime, railway development over Monmouthshire and South Wales had proceeded apace, in line with the expansion of the coalfields and the construction and development of ironworks.

The improved transport facilities and increasing overseas demand for high quality coals underlined the need for still further dock accommodation at Newport, and in July 1865 the Alexandra (Newport) Dock Act received royal assent. This Act authorised the forming of the Alexandra (Newport) Dock Company and the promoters were empowered to construct a new dock, 29 acres in extent, entirely separate from, and closer to the mouth of the river, than the Town Dock, together with railways to connect with the other lines already serving Newport. The new Alexandra Dock (which later became known as the Alexandra North Dock) was opened in 1875. In the year 1882 the original Newport Dock Company and the Alexandra (Newport) Dock Company amalgamated and became the Alexandra (Newport and South Wales) Docks and Railway Company. The era of expanding world trade continued unabated and the Company embarked upon an ambitious scheme for the construction of an additional dock to be known as Alexandra South Dock, with a deep water area of 96 acres. This was constructed in three stages—the northern section comprising 20 acres, with an entrance lock 72-ft. wide, was opened in June, 1893, followed by 48 acres of the Southern portion in 1907. The third and final section of 28 acres including the South Lock entrance, was completed in 1914, and was officially opened on 14th July in that year by H.R.H. Prince Arthur of Connaught, K.G. A feature of outstanding interest was the South Lock which measured 1,000-ft. long by 100-ft. wide, and was, at that time, the largest sea lock in the world.

The opening of the final section of the Alexandra South Dock completed the Dock Company's plans for the construction of additional accommodation; the extensive South Dock capable of taking the largest cargo vessels afloat, together with the North and Town Docks and River Wharves with their ample facilities for medium and smaller size craft, now provided Newport with a dock system well matched to the requirements of the still rapidly developing coalfields and heavy industries. The rate of expansion is clearly illustrated in the following records for the years 1875, 1913 and 1923:

		Coal and Coke. Tons	Other Traffics. Tons	Total Tons
1875	...	394,922	169,750	564,672
1913	...	5,928,060	1,201,780	7,129,840
1923	...	6,769,493	1,188,643	7,958,136

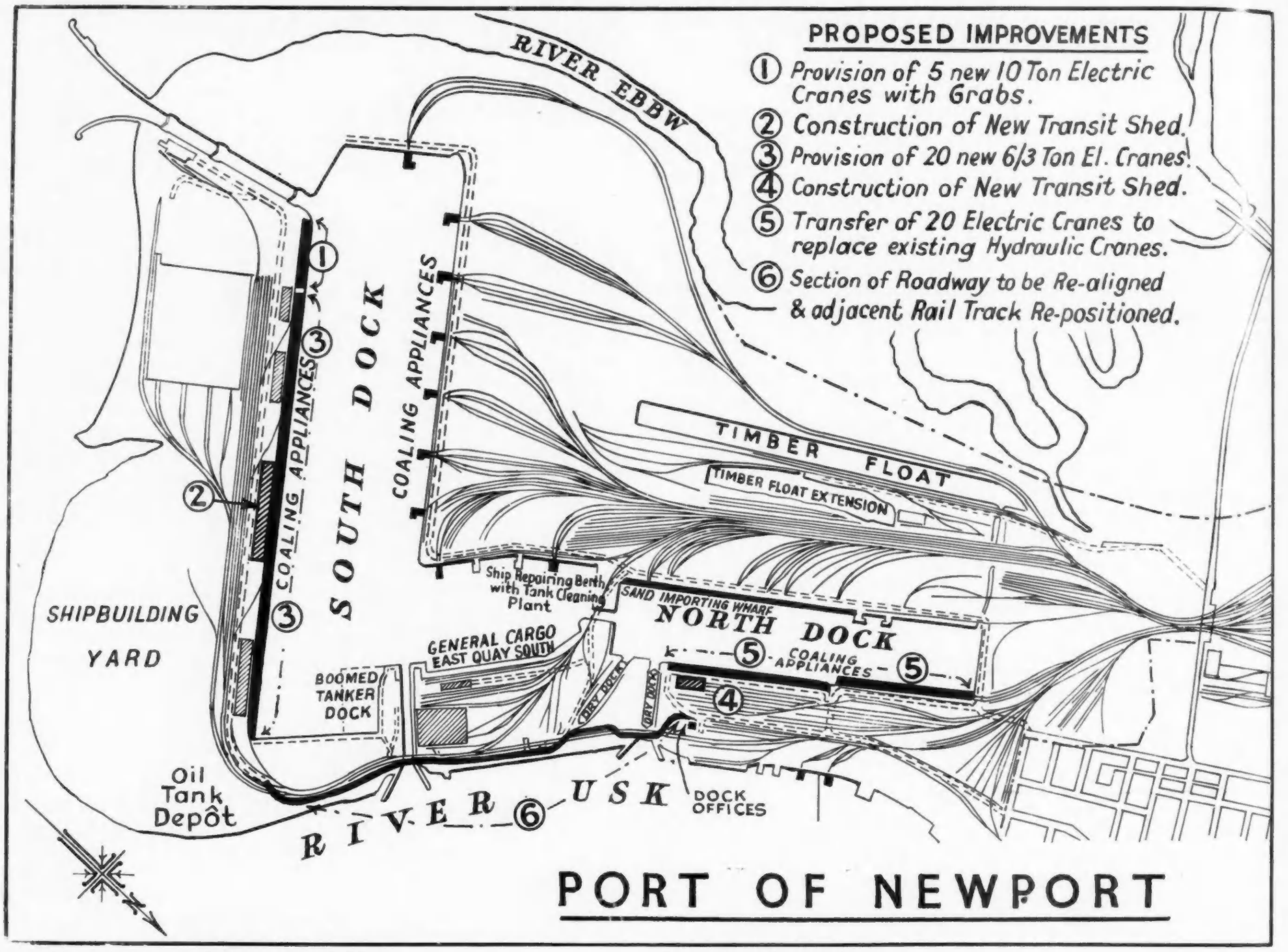
World demand for the high-grade bituminous coals of the Monmouthshire Valley had provided the real impetus for the construction of the docks, and the coal shipping facilities were progressively developed and improved both in the interest of quick despatch and the avoidance of breakage during shipping operations. The emphasis on coal may tend to give the impression that the quays were given over almost entirely to that one commodity, but that was not the case. The docks were planned and constructed to provide quite separate and extensive wharves, with associated equipment, for the import and export of general cargoes, the principle being to lay out coal shipping and general cargo berths on opposite sides of the docks. The general cargo export trade at Newport was developed steadily but surely and, in time, regular and frequent sailings to all parts of the world were scheduled by most of the principal Liner Conferences.

Changes in Ownership.

On 1st January, 1922, Newport Docks passed to the control of the Great Western Railway Company. Exports of coal were still running at the high level of almost 7 million tons a year, but with changing world conditions, the new owners were soon faced with a period of diminishing trade, and whereas the original owners had been hard pressed to develop the docks in step with expanding trade, the Great Western Company had to deal with quite a different problem. By 1930 the Town Dock had outlived its usefulness and was filled in, and attention was directed to maintaining the facilities of the Alexandra North and South Docks to the highest possible standard of efficiency. The benefits of this policy were fully experienced during the difficult years of the second world when Newport, in common with other South Wales Ports, played a notable part in the handling of vast quantities of war materials.

January, 1948, saw a further change in ownership when the railway-owned docks of the country came under the control of the British Transport Commission. Since the war, the trade of the port has centred around general cargo rather than coal, and today, Newport, already well equipped for the handling of import and export traffic, and well served by the principal cargo liner companies, is increasing still further its facilities for handling general cargoes.

Ports of South Wales—continued



Present-day Accommodation and Facilities.

The docks comprise the Alexandra North and South Dock connected by a passageway, and having a total deep water area of approximately 125 acres. Access to and from the sea is obtained by means of the South Lock, which is divisible into two sections of 600 and 400 feet. Because of the considerable tidal reservoir, there is a fast flow of water on the ebb, and the scouring effect is such that dredging in the river does not constitute a serious problem, the removal of some 350,000 cubic yards annually by a modern dumb bucket dredger and steam hoppers normally being sufficient to maintain depths of 41-ft. 6-in. at Mean High Water Spring Tides and 31-ft. 6-in. at Mean High Water Neap Tides. On account of the considerable range of tide, dredging is carried out on a day and night tidal basis, involving the crews living aboard and the provision of suitable modern accommodation.

Owing to the high silt content of the water impounded into the enclosed docks, some 300,000 cubic yards have to be removed annually by bucket dredging to maintain a depth of 33-ft. of water.

Locking and unlocking operations extend over a period of four hours before and four hours after high water. V.H.F. radio equipment is installed at the Pier Head for the purpose of sending and receiving messages relating to the arrival and departure of ships, and the lock staff also have the use of electronic megaphones to facilitate communications. At most of the principal berths within the docks, provision is made for connections to the General Post Office ship-to-shore telephone service.

Towage in the entrance channel and river is undertaken by the Newport Screw Towing Company Limited who operate four modern steam tugs. In-dock towage is performed by the one diesel and three steam tugs owned by the British Transport Commission, two of these crafts being fitted with extensive fire and salvage equipment.

Alexandra South Dock.

This is the larger of the two docks and has a deep water area of about 96 acres, being approximately 950-ft. wide. On the South side is located the main general cargo quay (South Quay) extending over 3,500-ft. in one straight length. For working purposes the quay is divided into six sections and the whole stretch of quayside is served by three sets of railway tracks, linked at convenient points to adjacent running lines and sidings. Thirty movable electric level-luffing quayside cranes are provided to cover the requirements of sections 1 to 5; twenty-four of these are of 3-ton capacity, and the remaining six have a lifting capacity of 6 tons. Floating cranes of a capacity of up to 100 tons are also available for heavy lift operations. No. 6 Section is equipped with hydraulic cranes of varying capacity which at present, are being replaced by five 10-ton movable electric luffing cranes, fitted with grabs. Four transit sheds are situated along the South Quay and these are equipped with up-to-date mobile cranes, fork lift trucks, and hand-operated hydraulic lift pallet trucks. The fork lift and pallet trucks are also utilised aboard ship to assist as required with stowing processes. At certain of the berths on the South Quay there is a quayside space for the stacking of materials requiring open-storage prior to shipment; and at all berths good rail and road access is provided to meet the needs of traffic not requiring to pass through transit sheds. Additional stacking grounds, with railway sidings adjoining, and mobile and steam railway cranes, if required, are available at a number of points away from the dockside, but within a short rail or road haul from the wharves.

On the eastern side of the South Dock at East Quay, South, is situated the principal berth for the discharge of iron ore and other bulk commodities, together with further facilities for the import and export of general cargoes. This quay is 800-ft. in extent and is provided with four sets of railway tracks along most of its length.

Ports of South Wales—continued

Shipping at Alexandra South Dock, Newport.

The major portion of the quay is allocated to a bulk-discharge berth. It is equipped with six 10-ton movable electric level luffing grabbing cranes, fitted with level-cut grabs of 43 cubic feet capacity, capable of discharging iron ore, etc., at the rate of 1,000 tons per crane per eight hours shift.

The facilities at East Quay, South, also include three 3-ton movable electric level luffing quayside cranes and a transit shed, whilst a further transit shed (operated by private traders) is located at the rear of the quayside transit shed. Quayside access to the privately operated shed is also available from the adjacent East Lock—approximately 600-ft. long and 72-ft. wide. Prior to the opening of the 1,000-ft. long South Lock, the East Lock was the main entrance to South Dock; it has since been sealed off at its river end and is now utilised as a supplementary general cargo berth and as a lay-by for vessels requiring to carry out repairs afloat. One 5-ton movable electric level luffing crane is available and the berth is provided with excellent road access. A 30-ton capacity fixed-type hydraulic crane is positioned at the north-western end of the East Lock.

The northern and western quays of the South Dock are laid out and equipped for the shipment of coal and coke, and are provided with hydraulically operated high-level fixed hoists with lifts up to 60-ft. above water level, capable of dealing with 20-ton capacity wagons. The hoists are served by ample feed and return roads together with the requisite weigh bridges for full and empty wagons; they are also equipped with anti-breakage appliances and light-lift cranes. "Norfolk Spade" digger appliances are provided to expedite the shipment of duff coals.

Alexandra North Dock.

This dock has a water area of some 29 acres and is approximately 500-ft. in width. On the east side the main quay is allocated exclusively to general cargo operations, and provides about 2,000-ft. of continuous berthage. The quay is equipped with 14 luffing-jib and 3 fixed-jib hydraulic cranes and has good rail and road facilities, within the reach of the cranes, along its whole length. Three sets of railway tracks are laid on the dockside and these are connected to extensive sidings adjacent to the wharves. Considerable space with siding connections (and the use of steam cranes if required) is allocated for the stacking of materials requiring open storage. The berths are utilised mainly for the importation of bulk traffic and the shipment of manufactured iron and steel products; principal import commodities comprise iron ore, bauxite, pig iron, pitwood and pitprops, sawn and baulk timber, sleepers and telegraph poles.

On the western side of the North Dock the major portion of the quay is laid out for coal shipping operations. At the southern end of the west side quay a private company operates a wharf for the importation and storage of sand and other building materials.

Parallel to the North Dock, on its western side, and connected to it by a canal, are two timber floats with a total water area of 15 acres, where imported log and baulk timber may be stored.

Railway Traffic Facilities.

Rail tracks within the docks area total approximately 109 miles including siding accommodation for some 14,500 wagons; railway weighbridges are installed at convenient points to deal with weighing requirements in connection with materials and goods imported, and rail-borne traffic arriving at the port for shipment.

The Docks and Town are served by frequent main line freight and passenger train services from and to the Midlands, London and other important industrial and commercial centres.

Dry Dock Accommodation.

One of the essential industries which must be established at any port of standing is that of ship-repairing and in this respect Newport is particularly well placed with five dry docks and related facilities for the efficient servicing of vessels. Details of dry dock accommodation are as follows:

	Length.	Width.	Owners.
"Eastern No. 1"	430 feet	56 feet	Mountstuart Dry Docks
"Eastern No. 2"	775 feet	65 feet	Ltd. (entry from River
"Tredegar" ...	712 feet	65 feet	Usk).
"Baileys" ...	454 feet	64 feet	Messrs. C. H. Bailey Ltd. (entry from North Dock).
"Commercial"	523 feet	50 feet	British Transport Commission. Available for general use (entry from North Dock).

In addition, Messrs. C. H. Bailey Ltd. have provided facilities for repairs afloat at Nos. 10 and 11 Jetties, South Dock. Cranes have been erected on the jetties and the berth is equipped for the cleaning and gas-freeing of oil tankers.

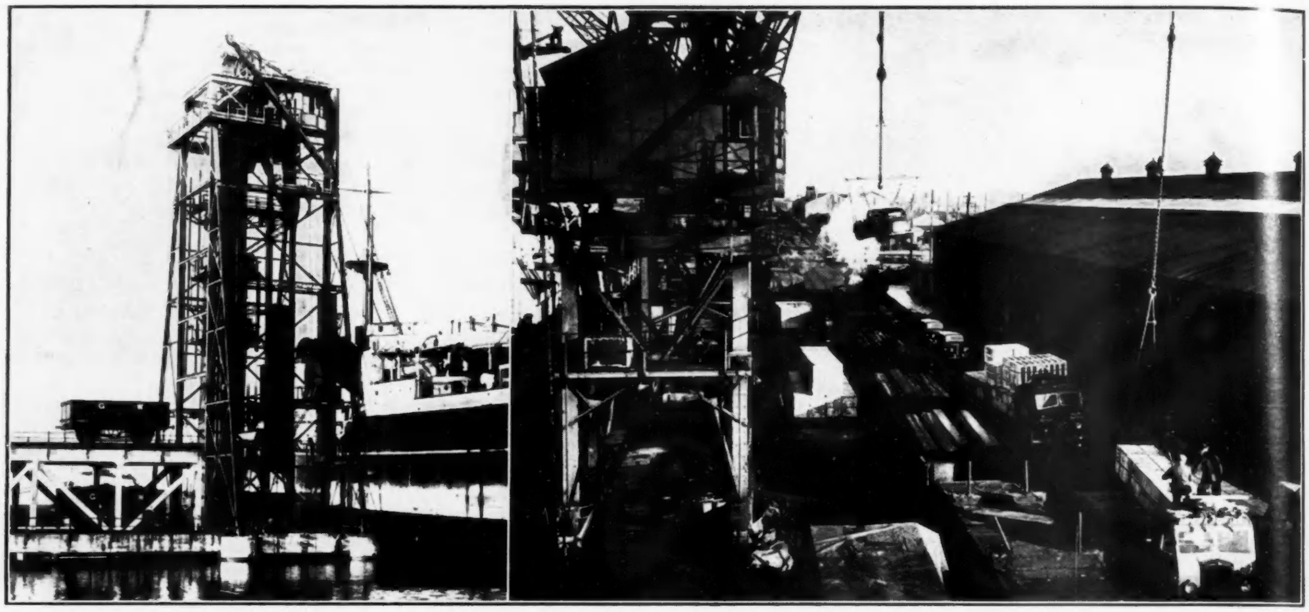
Post War Improvements.

The whole of the operating machinery comprising Coal Hoists, Quayside Cranes, Swing Bridges, and Lock Gate machinery was originally powered by hydraulic pressure. In addition there were two sets of steam-driven Impounding Pumps necessary to maintain the dock water level in view of the large tidal variation; also two steam-driven electric generating sets which supplied a certain area of the dock with electric power.

The whole of the steam-driven plant was installed before 1920, and the machinery is in remarkably good condition despite its age although in recent years its efficiency has decreased, due largely to the gradual replacement of hydraulic machinery by electrically operated appliances. Over 60% of the cranage at Newport is now electrically operated, and the next three years will see the total eclipse of hydraulic power in this field. Hydraulic power however is still used for a great deal of the port machinery including the coaling appliances, lockgate machinery, sluiceways, etc., and will continue to be required for many years to come

Fleet of Fork-Lift Trucks at work in Transit Shed, Newport Docks.

Ports of South Wales—continued



(Left): Coal Hoist unloading 20-ton Wagons at Alexandra South Dock. (Right): Shipping Motor Vehicles at North Dock, Newport.

Electrification.—It was evident that the electrification of the pumping stations would be a sound financial proposition, but there was not sufficient electrical capacity available on the dock estate to permit the changeover; indeed, this lack of available power was causing considerable embarrassment in connection with demands for increased capacity made by tenant industries on the dock estate.

Accordingly arrangements were made with the South Wales Electricity Board for the establishment of a 5,500 K.V.A., 11,000 volt supply and a modern ring main distribution system operating at 11,000 volts was installed, circling the dock. This main ring main connects to ten sub-stations situated at focal points around the dock.

With an adequate electricity supply available, attention was turned to the electrification of the two pumping stations and the North Station, which supplied hydraulic power only was dealt with first. In this station three pumps of the tandem multi-stage turbine type each capable of delivering 700 gallons per minute at 800 lbs. per sq. inch pressure were installed in stages in such a way that the station was in continuous service during the change-over, and the station layout has been designed for automatic operation.

The next step was the complete renewal of the pumping facilities at the South Station, including both hydraulic pressure generating equipment and dock impounding equipment.

The main equipment installed on the hydraulic side is as follows:

Three each—Hydraulic power generating pumps of the ten-stage turbine type each capable of an output of 350 gallons per minute at 800 lbs. per square inch, and driven at 2,980 r.p.m. by 300 h.p. direct on line Squirrel cage, 3,300 volt motors.

Two each—Low Lift pumps of the vertical spindle borehole type each capable of supplying 1,200 gallons per minute against a total head of 42.5 feet and driven at 960 r.p.m. by 25 h.p., 415 volt motors. These pumps supply a positive head of water for the hydraulic pumps.

All the above equipment has been arranged to operate automatically and many unique features have been incorporated.

In dealing with the impounding pumps, it was a great advantage that the culvert system was originally designed for three pumps whereas only two steam pumps had been installed. It was, therefore, possible to proceed with the erection and installation of the first of two new electrically driven pumps without disturbing the existing pumps which had to be kept in service during the change-over. The first electrically driven impounding pump was installed in the vacant position and set to work, after which one steam driven pump was removed for the installation of the second electrical pump.

The two new impounding pumps are of the mixed flow, vertical spindle, suspended type each capable of an output of 83,500 g.p.m. against a total head of 22-ft. and driven at 327 r.p.m. by 725 h.p. direct on line Squirrel cage motors operating at 3,300 volts.

Each pump, together with the gravity closing sluice valve and other auxiliary equipment associated with it, is designed to operate by the movement of one hand switch.

Improvements to No. 6 Berth, South Quay.

A major work now in hand is the modernisation of No. 6 Section Berth, South Quay, to equip the section as an additional berth for bulk discharge. This scheme provides for the replacement of the existing hydraulic cranes by five new 10-ton movable electric level-luffing cranes, fitted with grabs, and capable of discharging iron ore, etc., at the rate of 1,000 tons per crane per 8 hour shift. The work of installing electric cables and plug points along the quay, together with the strengthening of the crane track, has been completed. A start has been made on the erection of the new cranes and the whole of the work should be completed by the end of October, 1957. The Port will then have two deep water berths, fully equipped with up-to-date facilities for the expeditious turn-round of large bulk dry cargo carriers.

Future Developments.

Further improvements and modernisation schemes, which will involve an expenditure of over £1 million, and which are now the subject of intensive preliminary detail work are as under:—

South Dock: Construction of a new brick and steel transit shed at South Quay; the shed will have a floor area of 60,000 sq. ft. and the structure will incorporate two 3-ton gantry cranes. Ancillary equipment to be provided will include mobile cranes and fork-lift trucks. The Scheme will necessitate the re-siting of an electrical sub-station and certain minor structures.

Adjustments to electric ring main, replacement of sub-station, and modification of electrical distribution, South Quay.

Alterations to rail tracks to improve access to South Quay.

Provision of twenty new 6/3 ton movable electric level-luffing quayside cranes, with a working radius of 70-ft.

Provision of five electric capstans to replace hydraulic capstans.

Renewal of quayside electric crane plug boxes.

The concrete-rafting to rail level of quays at South Quay and at East Quay, South.

North Dock: Construction of a brick and steel transit shed at East Quay, North, together with ancillary works, including the provision of mobile cranes and fork-lift trucks. The shed will have

Ports of South Wales—continued

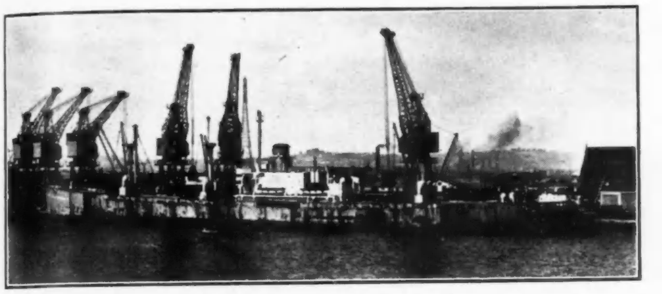
a floor area of approximately 16,500 sq. ft. and will be ideally suited to the requirements of the Continental coasting trades.

Transfer of twenty electric level-luffing cranes from South Dock to replace existing hydraulic cranes, and provision of electric capstans.

Provision of electric services including a sub-station and electric crane plug boxes.

Alteration of, and additions to existing railway tracks and sidings.

A section of the main roadway leading to South Quay is to be re-aligned, and adjacent rail tracks re-positioned, so as to eliminate a number of rail crossings and thus expedite the movement of rail and road traffic. This work will entail the consolidation of the river bank at two points and the demolition and reproduction of a number of small buildings.



New Iron Ore Quay equipped with 10 ton Cranes, Newport.

Private Developments.

In addition to these plans of the British Transport Commission, two important development schemes are in hand, within the docks boundaries, by private companies, namely:—

The Atlantic Shipbuilding Company Limited.

It is many years since an entirely new shipbuilding yard was constructed in Britain. Now, at Newport, a bold new enterprise is developing the dry dock system of shipbuilding and the prefabrication of ship section. The Company has leased from the British Transport Commission, a 58 acre site on the west bank of the River Usk and Phase 1 of the project has been completed. This comprised the erection of a large fitting shop and the construction of the first drydock 360-ft. by 60-ft. for building vessels up to 6,000 deadweight tons; this dock is now being extended to 540-ft. by 80-ft. for the construction of ships up to 16,000 tons. Work has also been commenced on the building of a second dry dock 755-ft. by 108-ft. to provide for the construction of larger vessels up to 45/50,000 tons deadweight, and the yard is being equipped with modern shipbuilding cranes and plant. The Company has already completed and delivered four medium size ships for Canadian owners, and has booked further orders for the construction of nine ships to a total value of approximately £13 million.

Shell-Mex and B.P. Limited.

This Company's project involves the establishment of a tanker-fed depôt for the bulk storage of petroleum spirit and oils intended for inland distribution. The scheme includes the construction of a jetty and boomed tanker-dock at the north-east corner of South Dock, connected by underground pipelines to a tank-compound within the depôt premises located on a 7 acre site near the west bank of the River Usk which has been leased from the British Transport Commission. The tank-compound consists of a number of vertical tanks, erected above ground, and having a total capacity of approximately 6,000 tons, together with the necessary protective works and ancillary equipment. The major portion of this work, and the laying of the pipe lines has been completed, and the construction of the jetty and boomed-tanker dock is well in hand.

The Trade of the Port.

With the physical and geographical advantages enjoyed by Newport and Monmouthshire, it is not surprising to find, in the area, some of the most important iron and steel, tinplate and aluminium works in the country. Some 21 miles inland at Ebbw Vale is located the great steel works of Richard Thomas and Baldwins, Ltd., which has recently been rebuilt on modern lines. Also there are the extensive aluminium works operated by the British Aluminium Co. Ltd. There are many other allied engineering works and foundries; a modern board mill; extensive timber yards; specialists in export-packing; a ship breakers' yard (the graveyard of many famous liners and fighting ships); chemical and fertiliser works; and a huge factory producing most of the nylon yarn and fibre made in Britain to-day.

The total imports at Newport Docks during 1956 amounted to 1,350,000 tons, including iron ore, bauxite, timber and other raw materials the bulk of which was destined for the works, factories and mines of Monmouthshire and South Wales. Exports (other than coal) totalled 355,181 tons made up of tinplates, steel sheets, and other manufactured iron and steel goods, motor vehicles, alumina, machinery, nylon yarn, chemicals and a variety of miscellaneous general cargo.

Dock Labour in the Port of Rotterdam

Review of Present Position

By R. LAAN Jr.
(President of the Dock Workers Section of the Dutch Transport Workers' Union).

After its liberation from German occupation in May, 1945, the Port of Rotterdam was left to face the vast devastations that remained. By close co-operation between the governmental and local authorities and the employers' organisation (called the Shipping Federation South) the reconstruction of the quays, sheds, cranes, etc., was taken in hand and notable improvements have been effected. Since that time the dock labour position has also been reorganised and the social status of the dockworker has been substantially improved in comparison with pre-war conditions.

Until 1940 nearly all the 10,000 dockworkers in Rotterdam were casual workers; only a few undertakings employed dockers on a permanent basis. However, during the war, when officially no trade union activity was allowed, discussions took place in secret between the employers and the unions with regard to the social status of the dockworker in Rotterdam once normal peacetime working in the port had been resumed.

Immediately after the war the dockers' unions put forward two main points. The first was that a decasualisation scheme should be set up with proper guarantees for the workers concerned. The second requirement was that an industrial pension fund for the dockers should be instituted.

Since then, in the past twelve years, a great deal has been accomplished and further progress is still being made. Much of the success of the scheme has been due to the spirit of co-operation and the willingness for understanding between the two main parties concerned, the employers and the workers.

Since January 1st, 1955, casual labour, as such, has ceased to exist in the Port of Rotterdam. From that date the former casual workers were absorbed into the service of the Shipping Federation South, which now acts as the sole employer for all the decasualised workers of the Labour Pool. A special body, the "Centrale voor Arbeidvoorziening" (Central labour Provision Service), was set up, to which some 5,000 dockers belonged.

At the present time about 9,000 dockers are employed in permanent service by various undertakings, such as stevedore companies or mixed stevedore/shipping companies. The number includes every category of worker from the docker to the foreman. All the 14,000 workers—those from the Central Labour Provision Service and those employed in permanent service—are covered by the Collective Agreement concluded by the Shipping Federation with the Unions. The only material difference is that dockworkers from the Labour Provision Service receive 80 per cent. of their wages for any unproductive time.

This means that all the 14,000 employed dockworkers are entitled to the same social conditions, i.e.

15 days holiday with 27 days pay for the period;

Full pay in cases of sickness or accident;

Dock Labour in the Port of Rotterdam—continued

Pension funds which, together with the state pension, assure the dockworker a pension of at least 60 per cent. of his pay on retirement.

Dock labour in the Port of Rotterdam, therefore, had reached a position which was in accordance with its contribution to the overall activity of the Port.

However, it was recognised that social status, as such, was not enough; it was also necessary to draw attention to the fact that dock work is skilled labour. The modernisation and mechanisation of the work in the port requires that the dock labour union plays a positive role in the training of all those employed in the docks.

Accordingly, in 1947, a committee was appointed to study the question of training for the Rotterdam portworkers. In 1949 the committee accepted some rules for the setting up of a training scheme. The scheme now consists of three phases, viz.:

(1) Basic training.
(2) Training of specialists.
(3) Training of foremen.

1. The Objects of Basic Training.

(a) To increase craftsmanship.
(b) To give a general training in fundamental principles.
(c) To teach the dockworker how to work safely and to train him to be conscious of the need for order and neatness.
(d) To teach the docker to work in a team.

The chief aim of the training is to increase professional skill; port work is a specialised trade.

By giving instruction in general principles it is hoped to improve the attitude of mind towards the work.

Throughout the training special emphasis is placed on safety, order and neatness.

Duration of the Training. The course covers a period of 13 weeks, if possible divided into nine weeks in the general cargo section, one week in the grain handling section and a three-week course in handling bulk cargo. The first training period includes one week of night work.

2. The Training of Specialists.

Pupils are admitted to the second period of training after they have taken their basic training certificate. The training of tallymen and checkers, also of deck hands and fork truck drivers is found under this heading. Here again the training period is of 13 weeks' duration and at least 15 men are trained on each course. The 15 are divided into five groups of 3, each of which is attached to a basic training group. At the end of the course there is a practical and theoretical examination.

3. The Training of Foremen.

The course for foremen forms the conclusion of the training. Here the object is to educate men capable of supervising the gangs of dockers. The course is both for the training of new officials and the education of those who are at present working in that capacity. For the latter category this training will be more than a readjustment course. Both labour and discussions define these courses. The "follow up" in practice from a pupil to an instructor is an important part of the training and should be considered as a basis for supervisors. However, the training of foremen is still not complete with this course. There are further courses, theoretical and practical, for supervisors in the general cargo, the bulk cargo and the check-taking branches.

In order to be promoted from the first to the second phase of the training and for admission to the third phase a candidate not only has to be in possession of the relative certificate but his general fitness for the position is also examined, i.e. by medical examination, judging during the training period, tests, discussions, etc.

Dock Labour School.

The training scheme so far described is a vocational one designed for adults. However, the bipartite supervisory committee felt that something was still needed at the beginning of the young dockworker's career. For other skilled professions, such as fitters, electricians, carpenters, etc., technical schools exist at which the young apprentices learn the main theoretical principles of their profession. It was therefore decided to set up a special dock labour school—a technical school for boys who leave the primary school at the age of 13 years. The school, which was established with the assistance of the Department of Education, has now been working for two years. The boys attend the schood until they reach the age of 16 and from 16 to 18 they are in an apprenticeship. This year the first examinations will be held for the boys finishing their apprenticeship. At the present time about 200 pupils are attending this special dock labour school and another new school is expected to be ready at the beginning of 1959 which will have places for 450 pupils.

Future Developments.

Although so much has already been achieved the dock labour union in Rotterdam has still further aims in view. A committee representing both employers and employees is at present discussing ways of obtaining a more regular working scheme for the Rotterdam port worker. If possible, it is desired to evolve a working scheme which assures the greatest possible flexibility and yet gives the worker in the port more regularity in employment; obtains shorter working hours and encourages the docker to feel that he is doing a responsible task and giving his skilled labour to an important industry. The problems of profit sharing and the determination of what is a justified wage for the docker and how it is to be obtained still remain to be solved. For instance, should it be obtained by a tariff or bonus system, by piecework, or could there be introduced into the dock industry a "fair job" classification, in view of the heavy work involved which, in the author's opinion, is analogous with that of the miner.

However, when it is considered how much has been accomplished in the last twelve years (during which time both employers and dockers' unions have worked together to find a solution) it is certain that these problems too will be resolved in time.

The most important factor, in the dockworkers' view, which has contributed to the development of the Port of Rotterdam since 1945 has been the recognition of his status. He is now recognised as a skilled and responsible worker and, on his part, he has learned to consider himself an essential part of the operation of the port.

Improvements at Dar es Salaam

Work has commenced at Dar es Salaam on improvements to dock facilities consisting of a railway siding linking the deep water berths with the industrial area, a new oil jetty, port offices and a dhow wharf. It is estimated that these projects will cost the East African Railways and Harbours Administration some £380,000.

The Administration is to provide a 4,000-ft. single line siding and an initial two rail spur with provision for a further five spurs when such are required. This rail link necessitates the cutting away of some 90,000 tons of earth from the bluff at the back of the deep water berths in order to effect the 1.5 grade from the berths to the warehousing area. The bulk oil jetty is expected to be completed early next year. It will replace the floating pipeline system now in operation and will comprise a T-head jetty with deck space of 200-ft. x 30-ft. at the end of an 850-ft. pier into which will be set the various pipeline facilities. It is designed as a composite structure of 18-in. steel piling with precast concrete capping beams and roadslabs, with the T-head cast in situ. After dredging operations are completed, the depth of water at coping will be 35-ft. L.W.O.S.T., a depth sufficient to accommodate vessels of up to 24,000 tons displacement. Vessels will be moored to two Peine dolphins in the harbour and, at the jetty, the mooring load will be taken up by two seventy ton bollards and gravity fenders set into the T-head. The pier is designed to carry a 16-in., a 10-in., and two 12-in. pipelines for fuel oil, heavy diesel oil and gas oil respectively and there is also a line for fresh water. The pierhead will include two 40-ft. observation towers and Foamite generators will be installed for fire fighting.

Construction is now in hand on a new dhow wharf which will have a T-head jetty, the pier head of which will be 150-ft. x 18-ft., linked to the shore by a 175-ft. jetty It is being constructed of 12-in. concrete piles with steel braces and timber decking. Work on the new Port Offices, which will comprise a three storeyed building of 36,000 sq. ft., will commence later this year.

Timber Handling Problems at U.K. Ports

Ship to Yard Handling, Sorting and Re-Delivery

By P. GRINDELL

THE Timber Handling Conference held at Manchester last year by the Timber Trade Federation of Great Britain produced a great deal of useful information. A wide range of handling problems and methods were covered in the four papers delivered at the meetings and they provoked interesting discussions. Readers of the Dock and Harbour Authority will be aware that reference to this Conference has already been made in previous issues and the following article by Mr. P. Grindell, of Burt, Boulton and Haywood, Ltd., is based on the Paper he read at the Conference and also includes a description of the sorting and re-delivery method employed by his Company at Belvedere.

The Method of Loading the Vessel.

The loading of a vessel is in the hands of the importer, for it is controlled by the loading orders which he forwards to his shipper. Due to the limit of the number of Bills of Lading which an importer may have without additional charge, it is customary for more than one size of European goods to be loaded on each Bill. This is due to the method of purchasing a mixed specification based on shippers overall production. Whilst this may be generally useful for selling purposes, the problems of sorting to size and length are increased with each additional size added to the Bill, and the cost of sorting is made greater.

On the other hand, the method of production in Canada and the United States enables the importer to purchase complete Bills of one size and one quality, if this is desired.

Alternative methods of shipping could be:

(1) Individual Bills of Lading for each size.

(2) Packaged shipment for each size.

In dealing with (1) we should need to consider the cost angle with particular care to determine whether the expenditure at the port of shipment would be justified by the saving in cost at the receival end. In addition, a great deal of thought would need to be given to the method of receival. There are often cases where goods from Bills of Lading of 20 Standards become mixed. How much more opportunity for error if the Bills were much more numerous and each consisted of a few Standards.

The shipment of "packaged" timber, as suggested in (2), is not impractical, and has been practised between New Zealand and Australia. The factors which the U.K. timber trade would have to consider are the following:

(1) Shippers willingness and ability to co-operate.

(2) Cost of packaging.

(3) Loss of stowage in the ship.

(4) Speed of loading and discharge.

(5) Weight of package.

The Chartering of the Vessel.

This factor alone may have a considerable bearing on the difficulty or ease with which timber can be handled. The reason lies in the well known fact that due to the seasonal nature of the Baltic trade the heaviest volume of the import has to be received and piled during a relatively short period. It is obvious that there will be a peak period as soon as the Baltic season opens. The result of this peak will be reflected in delays at the port of shipment due to the shortage of labour, railway trucks, etc. These delays will result in the complete dislocation of any plans which an importer may have made for the smooth flow of material into his yard. Furthermore, peaks always bring out the worst in all handling operations.

Methods of Sale.

Whatever method the importer may use, we return inevitably to the fact that in a number of places along the line between the ship and the stacking yard the timber will have to be tallied and measured. The only method of accurate measurement is for each piece to be handled and record taken of the length and size.

An ex-barge sale causes less difficulty in measuring, as the slower movement of the timber from the barge allows either a piece tally or a fully measured tally to be taken. In any event the receiver will require to re-tally to ensure that he has received the invoiced quantity.

If the sale is made on an ex quay basis, the timber will be delivered as it rises from the pile, and there will be no selection for size or length. The receiver will accept a piece tally and will subsequently stack and re-measure.

A form of handling which is widely practised is that of direct delivery from ship's hold to rail wagon. On receipt of the goods at the importer's premises the wagons are unloaded direct to customer's lorry or put into stock in the importer's yard.

The Final Storage Operation.

Piling of goods either in random specification or sorted for length is the most complex and at the same time the most expensive of the handling operations. It is not possible to lay down any principles since there are a large number of differing factors.

It is true, however, that the present day cost of timber has made both merchant and consumer very demanding in the way in which timber is purchased. Finance plays such a large part in all the operations that it will be understood quite readily that:

(1) Absolute economy in lineal waste is essential, together with an acceptance of the dimension which is right for the purpose.

(2) Timber which is not in condition will not be attractive unless the price is right.

The requirement set out in (1) means a greater degree of separation for length, more yard space to accommodate the stacks and very much reduced speed in sorting.

In the case of (2) the maintenance of satisfactory condition leads to a greater need for covered storage, and for greater speed in sorting and stacking. One of the worst causes of degrade is that of exposure of cargo to weather after it has been landed in this country.

In cases where re-delivery by machine has been adopted as standard practice within a yard, two forms of sorting and stacking have been used. These are:

(1) Preparation of a measured package of random specification.

(2) Preparation of a package in which there is a range of lengths but which will be easily tallied before despatch.

There are advantages and disadvantages in both methods. Individual experience can be the only guide.

Hardwoods, Plywood and Wallboard.

Many of these handling problems are equally common to hardwoods. The delay factor is even more serious since it concerns the decorative woods where exposure to weather will have a disastrous effect on their sale value.

There are certain advantages which may be derived from the fact that this class of timber is seldom shipped as a full cargo.

Material is generally taken into barge or ex quay from docks in small quantities capable of reasonably rapid clearances. On occasion it is possible to measure as the timber is discharged from the barge, to make up into stripped sets of 50 to 100 cu. ft. On the other hand, a large flow of material will make dumping an essential "buffer operation."

Plywood and Wallboard present a lesser problem because of the reduced amount of sorting. It is difficult to suggest an improved method of handling without a knowledge of the volume to be handled. In general it would appear that the fork truck has a number of advantages in this field.

Some Disadvantages of the Present System.

In all of the operations to which reference has been made there has been a "buffer" factor, between ship's side and the final stacking in the yard.

In the case of premises served by water,

Timber Handling Problems at U.K. Ports—continued

barges have been used as the floating storage which has enabled the sorting and piling to proceed steadily and without the double handling operation of dumping. The yard served by rail uses the rail wagon for the same purpose. For the yard served by road the method usually adopted is the purchase of goods on either ex quay or landed basis to ensure that the necessary breathing space is available.

In allowing receivers this breathing space, the available equipment of barges and rail wagons, and the available port labour force is being strained beyond the economic level at which they are customarily maintained. It is obvious that it would be impossible to have a situation in this country where there was sufficient equipment to cope with peak demands, as this would result in consistent under usage. The situation should be reached where with an average amount of facilities, and a limited amount of overtime working, it should be possible to cope with peak demands. This was not the case in 1955/1956. Due to War Damage, some of it not reinstated after 11 years, our docks were not able to give this service. There is no reason for complacency in the timber trade, since by the methods of "buffering" employed, the task of the dock authorities has often been made more difficult.

The use of buffer storage, and the payment of demurrage to avoid dumping or double handling, has the effect of tying up the limited number of barges and rail wagons. (There will be a limit imposed by economics on the number which are now available.) This in its turn results in the discharge of ships being held up as a consequence of non-availability of barges or wagons.

In the method of ship discharging operation it is not customary for the labour force to be switched away from a vessel where unloading has ceased due to the non-availability of craft or wagons. Labour is then uneconomically employed and a shortage may develop. With ships in the docks, unable to continue discharge, the berths are quickly taken up. The results are seen in a long line of ships awaiting their turn for unloading.

As a consequence, freight rates go up and the receiver pays more for his timber.

There is another form of buffer storage which is commonly used. This consists of direct discharge to store by ship's derricks or quay cranes. This method envisages the break-down of these bulk stacks from their place on the quay for further handling as follows:

(1) Ex quay delivery.

(2) Re-delivery to barge or rail wagon.

(3) Sorting and piling to size and length.

This type of handling results in the complete neutralisation of valuable quay space for a period of weeks. In certain cases this method has been modified by delivering to yard transit vehicles. After loading these vehicles transport the cargo to a dumping area.

After dumping the operations detailed above are performed.

A major problem which faces dock authorities is that they are often called upon to receive large quantities of timber at the time when importers are so fully committeed that they are unable to cope. This is the time at which the dock authorities themselves are also handicapped since the available labour force is already fully employed.

Labour unrest has added to our difficulties in recent years, for as soon as a strike has been settled, ship owners have been so anxious to clear their vessels that overtime has been worked day and night. The result has been that the receiver, although he may work some overtime, is quite unable to cope with the speed of discharge of the vessel. It has been estimated that the speed of discharge of the vessel is always twice that of the piling operation (after sorting). It will be clear that if ships work at night, then no timber yard working on conventional lines will be able to keep pace. Night sorting is seldom, if ever, practicable due to the lack of light and the increased hazards.

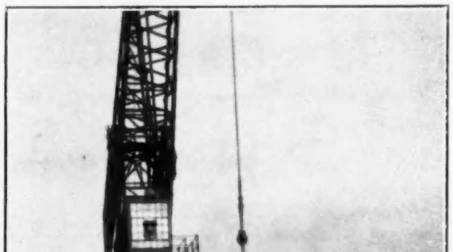


Fig. 1.

There are no text book solutions to the problems which face us. Each importer needs to form his own opinion as to how he can best overcome his difficulties. The objects he will keep in his mind are the following:

(1) Increased speed of stacking and sorting.

(2) Reduced demurrage and dumping cost.

(3) Improved availability to his customer.

(4) Reduced deterioration of stock, since it will be exposed to the weather for shorter periods.

(5) Reduced finance cost, since stock is available for sale shortly after arrival.

(6) Speedy availability of landing return of material received to enable the receiver to check the quantity received against the shipper's invoice.

The sorting table technique was developed to give the anwers to these problems. The object is to sort and pile cargo as fast as the ship can discharge. We have found that our own installation will almost give this answer.

Handling Method employed at Belvedere.

At the Thames side wharf of Messrs. Burt, Boulton and Haywood Ltd., an installation consisting of conveyor chains has resulted in the doubling of the sorting and stacking capacity. As is customary in timber carrying vessels the cargo is very closely stowed, to obtain the best possible freight rate per unit carried.

On arrival, gangs of National Dock Labour workers discharge the cargo, making it up into sling loads or sets to be discharged

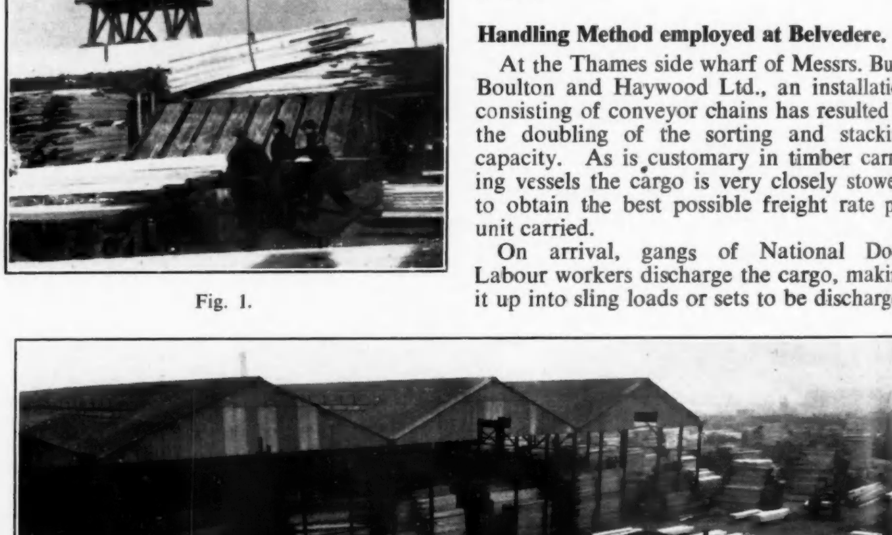


Fig. 2.

Timber Handling Problems at U.K. Ports—continued

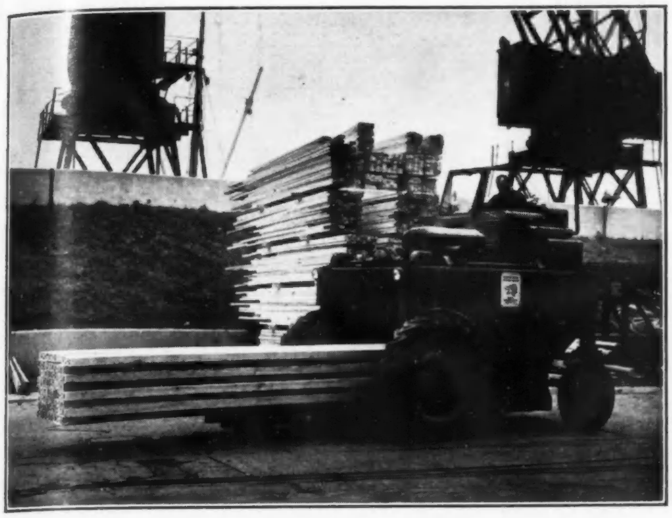


Fig. 3.

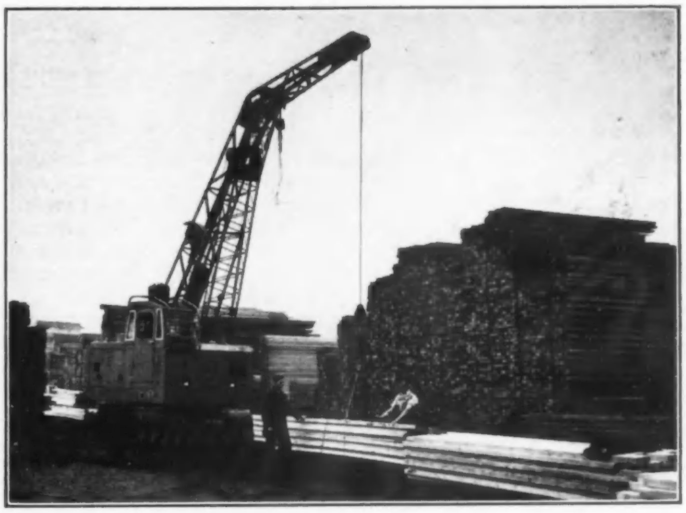


Fig. 4.

to the sorting tables by electric wharf cranes (Fig. 1).

The timber passes along the conveyor chains and is sorted to length and size by further gangs of Dock Labour men (Fig. 2). The timber is stacked on small trolleys which can be seen on either side of the tables.

As soon as the trolley has been loaded to the correct height, it is pushed away from the side of the table into a position for the straddle carrier to take up the load. This operation is demonstrated in Fig. 3 showing the straddle carrier passing over the loaded trolley. The loose bolsters on the trolley together with the package of timber are lifted clear, and the empty trolley is returned to the tables for reloading.

The load is taken by the straddle carrier to the stacking area which has been designated, either in the open or under sheds. The load is then lowered on the bolsters and left for the piling gang to stack.

Fig. 4 shows the method of lifting for open storage.

Fig. 5 shows stacking under cover. It is interesting to note the thick "main sticks," which give stability to the tiers of the stack and also act as skids to enable the wire bonds to be drawn clear after the lift has been completed.

The new method has many advantages over that previously employed in that it reduces dumping to the minimum and avoids additional haulage charges from the ship's side. In avoiding dumping, the space which was formerly used for this purpose is used for stacking alone, and the material is available for sale immediately.

Control has been improved to a very considerable degree, both of the out-turns and of inspection of the material.

The speed of stacking after receipt from the vessel has ensured that goods are stored in first-class condition, and without deterioration due to inclement weather.

It would be possible to keep up with the speed of discharge from each hatch if longer sorting tables, more straddle carriers and

Fig. 5.

more men were used. One sorting table would be necessary for each hatch.

But since there may be a variation in the method of sale, CIF, etc., there is no point in providing for maximum discharge per day over the sorting tables. The Company has balanced its import volume, its average handling method and its equipment to maintain a smooth, uninterrupted throughput during the season.

It is unlikely that a replica of this solution to the problem will be suitable for any other yard, but it is suggested that a use of a technique developed around the sorting table principle could provide the answer to sorting and stacking of softwoods and for the measurement, sorting and stacking of hardwoods.

In any event the method of material handling which an importer will adopt to arrive at an improvement in his throughput will depend on a large number of factors, some of which are enumerated below:

(1) Size and spread of import.
(2) Size and contour of the stacking yard. Quantity of paved or hardened surfaces. The amount of shedding available. Whether sheds are accessible to cranes, fork trucks, trolleys, rail wagons, etc.
(3) The method by which the yard is fed —water (ship or barge), rail or road.
(4) Method of inter yard handling.
(5) Length of quay, method of discharge. Length of rail siding, roads, etc.
(6) Labour quality, skill and availability. Relative cost.
(7) Type of trade undertaken.
(8) Degree of length selection.
(9) Method of stock accounting.
(10) Method of re-delivery.

In conclusion, it must be stated that there is an economic limit to the introduction of materials handling improvements. The reference is made to materials handling, and not to mechanical handling, for it is often possible to improve such things as work method, by the introduction of work study. As a result of such studies, incentive schemes can be introduced which will improve the output without large capital expenditure.

Materials handling does not automatically envisage expensive plant.

It is only by careful study with a complete knowledge of the factors involved, that an economic solution of the problems may be found.

Erratum: New Shipborne Radar Set.

Messrs. Philips Telecommunications Division, Hilversum, Holland have asked us to point out that a printing error occurred in the brief notice on the above subject which appeared on page 70 of the June 1957 issue. The beam width of this close-range radar unit, operating on the 8 mm. waveband was stated to be 3° whereas the actual width is 0.3° as can be deduced from the dimensions of the antenna and the wavelength used.

The Construction of No. 1 Berth, Tilbury Docks

New Passenger and Cargo Terminal for Port of London

TILBURY Docks are situated some 26 miles below London Bridge and of the Port Authority's five systems of docks are nearest to the sea. For many years the largest vessels of the P. & O. Company and of the Orient Company engaged on the Indian and Australian routes have been based at Tilbury and a large passenger as well as cargo traffic has therefore been conducted at these docks. These ships normally embark and disembark passengers at a cargo transit shed, but when the tide is unsuitable for locking, passengers use the Landing Stage in the river just below Tilbury Basin.

Tilbury Docks were built in 1886 by the East and West India Docks Company and were designed to accommodate 31 vessels averaging 400-ft. in length. There was a main dock with three branch docks extending northwards, and the total water area was 52½ acres. The original lock entrance was on the south side of the main dock and connected with a tidal basin which was entered from the river in Gravesend Reach. In 1916 the main dock was extended westwards and three additional berths were provided on the south side. In 1928 a new lock entrance was built at the western end of the main dock, and at the eastern end a dry dock was constructed. In 1930 the Landing Stage and adjoining Baggage Hall were completed.

The entrance lock at Tilbury is 994-ft. long, 110-ft. wide and has a depth of 45-ft. 6-in. below Trinity High Water (11.4 N.D.) which is about 1-ft. above M.H.W.S. Based on advice from Lloyds Register that the probable dimensions of ships would reach the ratio

$$\text{beam} = \frac{\text{length}}{10} + 24$$

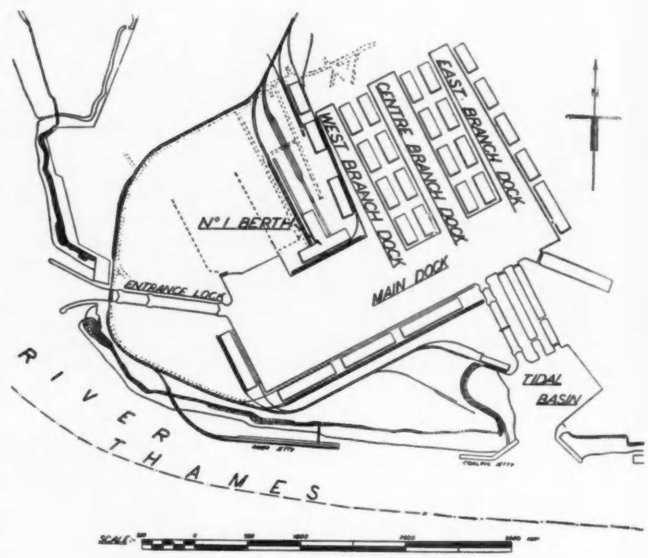
it could be estimated that the maximum size of ship which would pass through the lock in future would be 810-ft. long x 105-ft. beam and it was decided that development inside the dock should be designed to accept ships of these dimensions which accorded reasonably well with the direction in which the new ships of the P. and O. and Orient Lines are tending.

Since 1948 the "Himalaya," "Iberia" and "Arcadia" have been built for the P. and O. Line and the "Orcades," "Oronsay" and "Orsova" for the Orient Line. All of these ships are of similar size, the largest being of 29,754 g.r.t. The maximum separate dimensions are length 723-ft., beam 93-ft. 6-in., loaded draft 31-ft., carrying up to 1,500 passengers and 2,000 tons of cargo.

In 1952 therefore the Authority decided to construct a new berth, known as No. 1 Berth, at Tilbury Docks for use by this increased number of ships approaching 30,000 g.r.t. and, in line with modern practice at ocean terminals at other ports, to provide a high standard of comfortable and convenient accommodation for passengers and their friends.

Location.

The new No. 1 Berth is located on the north side of the main dock which has been widened from 600-ft. to 900-ft. to give an increased ship-manoeuvring area and to enable larger vessels to



General lay-out of No. 1 Berth, Tilbury Docks.

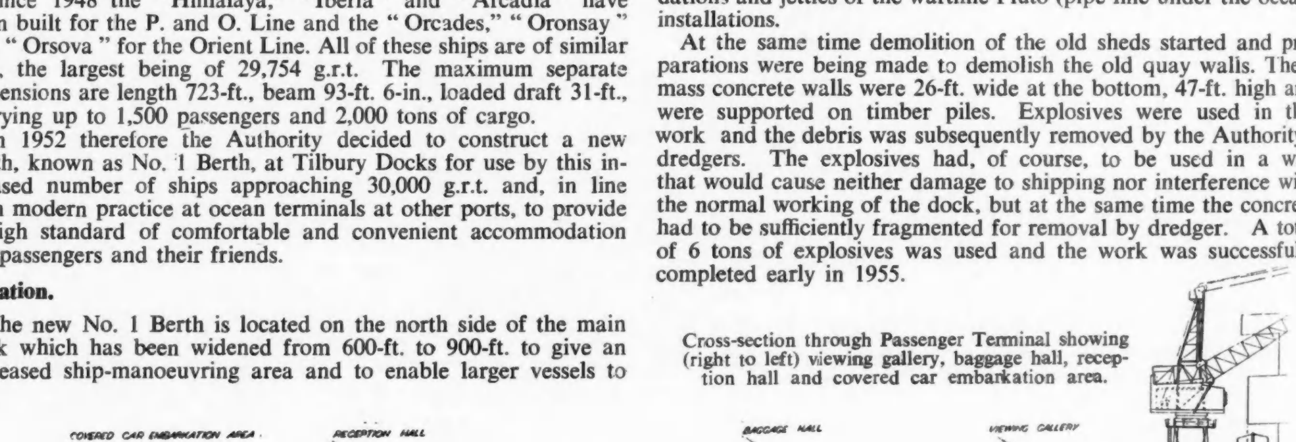
turn into the West Branch Dock. The new quay is 842-ft. long with a return quay of 240-ft. at the west end.

Widening the main dock necessitated the removal of the old Nos. 1 and 2 Sheds and the demolition of about 450-ft. of the existing mass concrete quay walls.

Demolition.

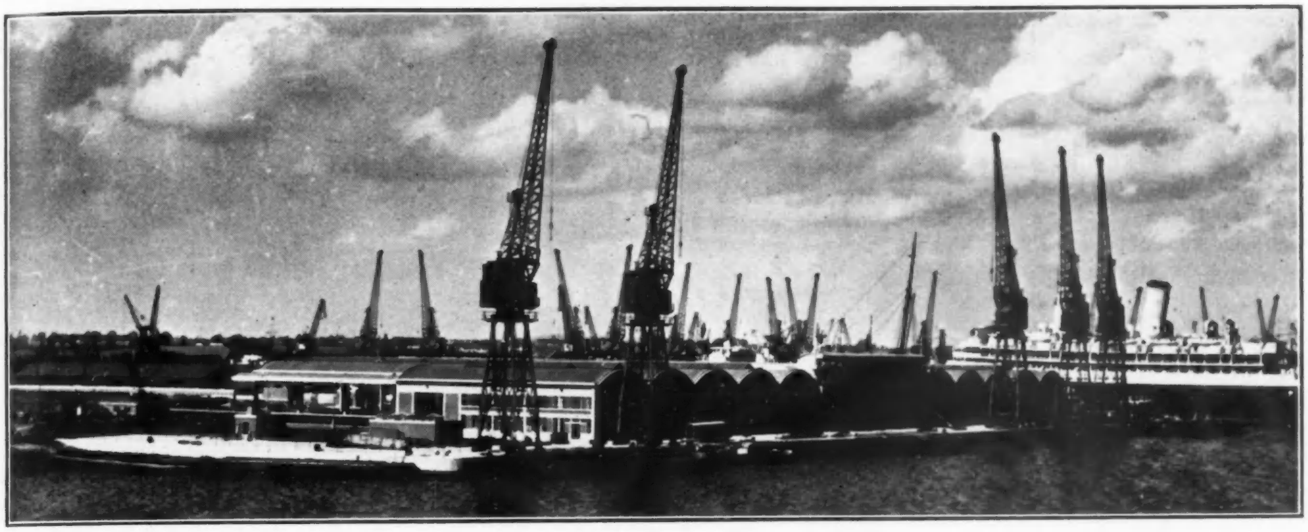
The Authority's contractors began work on the site in June, 1953, and one of the first tasks was to demolish the concrete foundations and jetties of the wartime Pluto (pipe line under the ocean) installations.

At the same time demolition of the old sheds started and preparations were being made to demolish the old quay walls. These mass concrete walls were 26-ft. wide at the bottom, 47-ft. high and were supported on timber piles. Explosives were used in this work and the debris was subsequently removed by the Authority's dredgers. The explosives had, of course, to be used in a way that would cause neither damage to shipping nor interference with the normal working of the dock, but at the same time the concrete had to be sufficiently fragmented for removal by dredger. A total of 6 tons of explosives was used and the work was successfully completed early in 1955.



Cross-section through Passenger Terminal showing (right to left) viewing gallery, baggage hall, reception hall and covered car embarkation area.

The Construction of No. 1 Berth, Tilbury Docks—continued



General view of the new No. 1 Quay and Shed.

Monoliths.

From previous experience of construction at Tilbury and information obtained from borings on the site of the new quay, it was known that there was a depth of 50-ft. or more of clay and peat which had to be penetrated before a foundation could be obtained in the gravel or chalk. It was therefore decided that the quay would be supported on 30 monoliths each 30-ft. square varying in depth from 50-ft. at the east end to 72-ft. towards the west end. The original mass concrete dock walls were constructed in timbered trenches which it was possible to keep dry by pumping, but after the dock was brought into use it was found that the water seeped into the excavations making it impossible to pump out and excavate to the required depth. Therefore monoliths which can be sunk from the surface have been used for all the extensions at Tilbury.

Each monolith has four openings or wells each 10-ft. 6-in. square, the internal and external concrete walls are 3-ft. thick except for the bottom three-and-a-half feet which taper to a reinforced concrete cutting edge 9-in. wide. The monoliths are constructed in a shallow trench on the line of the quay. After being built to a height of 11-ft. sinking of a monolith is begun by placing 6-ton cast-iron kentledge blocks on the walls and grabbing out the material in the wells by derricks. By this means the monolith gradually sinks into the ground. When the top is about 2-ft. above ground level, the kentledge blocks are removed and the monolith walls are extended with additional lifts of concrete. After the concrete has hardened, additional kentledge blocks are added and the process of sinking continues. This goes on until a foundation is reached in the gravel or chalk, the wells are then sealed with a depth of 12-ft. of concrete and the back wells completely filled with concrete to increase the stability of the monoliths.

It is interesting to note that the total weight of a monolith varied between 3,160 tons and 4,200 tons depending on depth, and the maximum weight of kentledge placed on a monolith during sinking was 1,600 tons.

Quay, Services and Equipment.

Reinforced concrete beams were constructed on the monoliths to support the quay. A service subway is provided behind the cope for electric cables, fresh water main, and telephone cable. The total width of the quay is 51-ft. and there is an 18-ft. gauge crane track and a railway track. The quay is equipped with four 3-ton and one 5-ton electric cranes, having 96-ft. jibs with an outreach of 90-ft. and a height of 60-ft. to the cab floor.

Dredging.

Dredging began in front of the quay in July, 1955, and approximately 500,000 tons of clay and peat were removed by the Authority's dredgers and dumped at Black Deep in the Thames Estuary some 44 miles from Tilbury. The depth of water alongside the quay is 38-ft. and the total water area of the dock has now been increased to 113 acres. The quay was brought into use for laying up on 31st July, 1956, when the s.s. "Lodestone" came alongside.

Shore Lay-out.

Whilst construction of the quay was progressing, drawings were being prepared in the chief engineer's office for the new transit shed, passenger platform, roads and railways; site work beginning in May, 1955.

The general policy for the construction of the transit shed was that provision should be made for import and export cargo and passengers in a general purpose building, which achieved a satisfactory appearance by the intelligent use of the basic constructional materials and which would stand the heavy wear associated with handling goods without excessive maintenance costs.

The "T" shaped cargo transit shed and passenger terminal has a frontage of 532-ft. along the main quay, and extends 430-ft. northwards from the front of the shed. The two arms of the "T" are each 122-ft. wide and form normal transit shed accommodation (combined area 48,800 square feet) and the centre section provides for an ample baggage hall (area 29,000 square feet) leading to a reception hall, covered car park and railway platform.

Office accommodation has been provided on mezzanine floors with Customs lock-ups and baggage stores underneath.

Shed Construction.

The shed of reinforced concrete construction with barrel vault shell roofs supported on columns on a concrete pile foundation. Generally the roof shells are 122-ft. long by 41-ft. by 30-ft. 6-in. radius, except over the Reception Hall where the shells are 61-ft. long. The concrete thickness of the roof is 3½-in. with local increases in thickness at the vertical edge beams, end wall tie frames and glazing openings. Lantern type roof lights are located along the centre of each shell. By this method of construction the roof spans the entire width of the shed without internal columns.

Roof.

The roof is insulated externally with 2-in. of vermiculite concrete and waterproofed with three layers of bituminous felt. The undersides of the shells are painted white except in the Reception Hall where the roof has been sprayed with a decorative insulating material.

Walls.

The walls of the building are of 9-in. brickwork with glass brick windows and the main doors are of timber construction. Light-coloured bricks have been used internally. An unrestricted work-

The Construction of No. 1 Berth, Tilbury Docks—continued

ing height of 20-ft. is available throughout the building including the door openings.

Floors.

The floors of the cargo wings and Baggage Hall consist of reinforced concrete rafts 6-ft. 6-in. square by $4\frac{3}{4}$-in. thick laid on sand; when settlement occurs these rafts can be lifted and rebedded in order to maintain a level floor surface. The floor of the Reception Hall is supported on piles.

Platforms.

The platforms around the shed are generally 15-ft. wide and ramps allow access by electric trucks, trolleys, fork-lift trucks and mobile cranes. The platform adjoining the railway on the west side of the building is 20-ft. wide and is roofed by a single cantilever shell-concrete canopy for the 300-ft. length adjoining the building. This platform extends 600-ft. northwards beyond the covered car park and is roofed by a reinforced concrete double-cantilever "butterfly" canopy, so providing a 900-ft. long passenger platform.

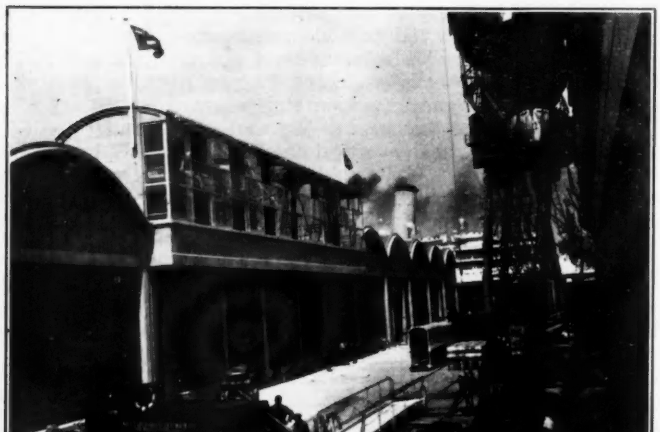
Fire Risk.

With the ever-growing demand for more space for working machines and stacking goods a constant watch has to be kept on fire risks. Given the excellent fire-fighting service which can be guaranteed for the docks in London, the constant vigilance of the Port Police and the highest grade of fire-resistant construction, the maximum permitted dimensions have been suggested as 50,000 to 60,000^2-ft. in transit sheds and 30,000^2-ft. for warehousing. The figures agreed with the Fire Offices Committee take into consideration the possible combustion load which may be concentrated in a building. In the case of No. 1 Shed the layout could be divided conveniently into three sections with fire break walls and fireproof doors, between each section.

Viewing Gallery.

In order to cater for friends of passengers, a viewing gallery overlooking the quay has been provided along the front of the Baggage Hall, with access through the adjoining cargo wings. The viewing platform is carried out in simple materials and a bold colour scheme. The structure is substantially in reinforced concrete so far as the two platform levels and the end walls are concerned. The rear wall and roof are in steel framing clad with aluminium decking. The former is lined with asbestos units fixed with aluminium fillets but the segmented roof is left unlined, showing the troughlike corrugations of the aluminium and the curved rolled steel principals.

The upper platform is carried on a single line of mushroom-headed concrete columns and is surrounded, together with its twin staircases, with robust handrails of a nautical design.



General view of new Berth looking east, showing the viewing gallery for visitors and passengers' friends.

New No. 1 Berth and Terminal Building, Tilbury Dock. View from quayside.

Bold colours are used in the painting of concrete and other wall surfaces and roof steelwork, which contrast with the natural aluminium ceiling and sheathing to window side structures. The aluminium frames to the sliding windows are also in their natural colour.

Coloured rubber flooring throughout the gallery and the staircases leading up from the baggage hall add further cheerfulness to the colour scheme.

Baggage Hall.

The Baggage Hall is used for Customs examination of passengers' baggage and for immigration formalities. Investigations were carried out in conjunction with H.M. Customs to improve the flow of passengers with their baggage and approximately 400 passengers can be dealt with per hour. When not required for passenger traffic, the portable Customs benches are removed and the area becomes available for cargo.

From the Baggage Hall passengers are directed to the boat trains at the railway platform or to the covered car park via the Reception Hall where they have the opportunity of meeting their friends.

Car Park.

Passengers travelling by road enter their cars in the covered car park which has 20 pick-up points, or can join their cars in the adjoining areas where 700 cars can be parked. Cars required in the covered car park are called forward from the outside parking areas by use of a public address system controlled from the Reception Hall; this system also operates in the Baggage Hall and viewing gallery at the front of the building.

Reception Hall.

The Reception Hall is designed as a meeting place for passengers and friends, and banking, travel, communication, refreshment, toilet and waiting facilities have been provided. The circulating space in the Hall is on three levels corresponding to the covered car park, the Baggage Hall floor and the ceiling of the offices, etc. It is considered that these changes of level inherent in the design will assist the meeting of passengers and friends by giving better visibility. A statue of St. Christopher and a large black and white mural have been incorporated as features of the design.

Seating is provided by settees and chairs upholstered with foamed latex and "Vynair" covering and the equipment also includes small tables. Electric floor heating is used in the Reception Hall in addition to a heating and ventilation system.

The general treatment of the Reception Hall at low level is in hardwood—primarily African Walnut—with colour relief in metal guard rails, mosaic columns, panels of coloured tiles and aluminium framed doors. The floor, in thermo plastic tiles, is also

(Continued at foot of following page)

Book Reviews

Free Ports and Foreign Trade Zones. By Dr. Richard S. Thoman. Published by the Cornell Maritime Press (Cambridge, Maryland, U.S.A.) and obtainable in the United Kingdom from Putman and Company Ltd. Price 52s. 6d.

This book deals with its subject most comprehensively and is, in fact, a review of the development of free ports to the present day, with emphasis upon specific examples drawn from North-West Europe—examples which have been models for the foreign-trade zones of the United States. One of the author's main objects, however, has been to examine exactly how much use the free port system is to the economy of his own country.

After describing the historical development of the free port—which, for centuries, of course, has served to permit goods to be stored, repacked, manufactured and re-exported without customs formalities—Dr. Thoman devotes a chapter to an appraisal of the free ports of Germany, a nation which has accepted the system more completely than any other.

The free ports of Scandinavia were modelled upon those of Germany. Nevertheless, the author states, there is a major difference between the concept in the two areas, "for there does not exist in Scandinavia the sense of free port and earlier free city tradition that enters so strongly into discussions of the device in Germany, particularly in Hamburg and Bremen. The Scandinavian free port must stand or fall solely upon its contribution to the commerce of its associated seaport and the economy of its host nation."

Such a book would not be complete if it did not examine alternatives to the free port device and Dr. Thoman describes the bonded warehouse systems obtaining at Rotterdam, Antwerp and London. His conclusions are interesting. "With allowances made for differences among the nations in customs and related regulations, a case can be made for either the free port or the bonded warehouse. It would appear that the modern free port, if it is to be successful, must be a large unit and furthermore must be associated with a large and active seaport. The bonded warehouse system appears to be equally efficient in large seaports and offers the additional advantage of adjustment to small seaports, airports and similar localities."

In the United States, the author says, efforts to introduce the free port system began as early as 1894 and continued intermittently without success until 1934, when the Foreign-Trade Zone Act received Congressional approval. This Act is generally similar to free port legislation in Northern Europe; it is standing legislation, in that no further Acts are necessary for the creation of new zones; and its wording is broad, in that it is concerned with the concept of a zone and not with a specific zone. To date, seven permits for operation have been granted, as follows: City of New York (1937); Port of Mobile, Alabama (1937); Port of New Orleans (1947); Port of San Francisco (1948); City of Los Angeles (1949); Port of Seattle (1950); and airport of San Antonio, Texas (1950). It is interesting to note, however, that of these seven zones, one (Mobile) functioned for only six months, a second (San Antonio) for only three years and a third (New Orleans) has announced its intention to cease operating.

In his concluding remarks, Dr. Thoman emphasises that "free ports and foreign-trade zones of highly-industrialised, tariff-enclosed nations must demonstrate that they can compete successfully with bonded warehouses or other alternative systems, if they are to persevere. So far, they have not evidenced an ability to do this when (1) they have been placed in small seaports or airports, (2) they have been introduced as very small units in active seaports or (3) they have been inserted into seaports, large or small, of which the commerce is not conducive to free port operations . . . .

"The outlook for the foreign-trades zones of the United States does not appear to be too bright at this time . . . . The results of the research for this book have indicated that the United States should not consider the establishment of any additional foreign-trade zones until the Great Lakes—St. Lawrence Seaway has become a reality and its traffic stabilised. At that time, studies should be conducted concerning the all-over efficiency of the foreign-trade zone, as compared with the bonded warehouse . . . . If the results of this study favour continuation of the foreign-trade zone, such a zone should be planned on a scale sufficiently large that it has a valid chance for success. If the results are negative, steps should be taken towards repeal of our (U.S.) foreign-trade zones legislation."

"The Geography of the Port of London." By James Bird. Published by Hutchinson University Library. Price 10s. 6d.

The story of the Port of London scintillates like a well-cut diamond, whichever facet is observed.

Geologists find a wealth of interest in its physical development and some mystery still; historians reach many of the peaks of "our rough island story" by studying the record of the River Thames.

Literature from Strabo and Tacitus through Chaucer and Dickens to H. M. Tomlinson dwells on its banks and artists such as Canaletto, Turner, Whistler, Wylie and the Wapping Group fill in the colours.

The engineer finds an ally in its tractable littorals which nonetheless pose problems to stimulate his ingenuity.

Tidal vagaries and siltation problems continue to tax the experts in the field of hydrography and its kindred research, obliging them to welcome every new discovery such as echo-sounders or radio isotopes to aid them in their attempts to unravel the enigmas set by the ancient river.

Merchant and shipowner, tugowner and bargee, wharfinger and industrialist, all are keenly interested in the development of the port, often finding the guiding hand for the future in the records of the past.

Finally, the man-in-the-street discovers with astonishment, when his attention is drawn to the facts, how much he has been, and still is, dependent on the good humour and discipline of Father Thames and the enterprise of those who administer the port he serves.

Dr. Bird has, probably reluctantly, jettisoned literature and art from his study and has adopted the factual approach in producing an authentic work on a very complex subject.

Until the publication of his work, Rodwell Jones' "The Geography of London River" was usually quoted as the standard work of this type of study. Now a fresh appraisal of the position, seen nearly thirty years later, provides a complementary volume for the bookshelf.

Dr. Bird, in a full yet concise survey stirs the memory and stimulates new thought.

The Construction of No. 1 Berth, Tilbury Docks

(continued)

colourful and the furniture has been chosen to harmonise with the overall colour scheme and to maintain a cheerful atmosphere.

The upper levels of the Hall are finished in brickwork carefully chosen as to colour to unite the warm tones of hardwood panelling below with the cool green and ivory vermiculite sprayed on to the concrete vaults and beams. Splashes of heraldic colours are provided by large enamelled coats of arms of six Commonwealth Countries, placed at high level in the segmented gable ends.

The Hall is illuminated by long lantern lights in the concrete vaults and by large windows constructed of glass lenses in concrete frames. Artificial lighting is carried continuously along the beams carrying the concrete vaults and around the cornice. This is designed to provide general illumination while local brilliance is achieved in entrance lobbies and bars by the use of fittings fixed at close centres under the ceilings, which, being painted a rich red, provide a good background to the bright spots of light.

The detailing of all joinery metal work and other trades has been directed towards a clean contemporary effect without any stylish affectations.

The Shed was brought into use for cargo in January, 1957, and all work was completed by June. The total cost of the scheme including demolitions and cranes was £1,590,000.

The works were designed and carried out under the direction of the Chief Engineer of the Port of London Authority, Mr. G. A. Wilson, M.Eng., M.I.C.E., M.I.Mech.E. The main contractors were Messrs. Holloway Bros. (London) Ltd., and Messrs. Kenneth Lindy, Joseph Hill and Partners were retained as consulting architects for the detail planning and interior decoration of the Reception Hall and Viewing Gallery.

Book Reviews—continued

Particularly refreshing is his theme; that of defining the port in terms of its function rather than in terms of its form. The legal definition in the Acts of Parliament is exhaustive and exhausting to all but the legally minded. Physical definition is a mere framework upon which to erect a structure of fact. Both are dull by comparison with the functional definition which is illuminating and enables the reader to discern at once something of the significance of the ramifications of business which accrues from the " each-way exchange between land and water transport."

The book consists of nine main chapters, beginning with a geological survey then running through the history of the 12th to 18th centuries. The " Water Highway " is studied in some detail and each of the five great dock systems surveyed. Reviews of the river traffic, riverside wharves, industrial development of lower Thameside and of the markets and trade, follow in sequence and the book concludes with some notes on the work of the Port of London Authority.

Maps and diagrams adequately support the text, while the cross-references and bibliography are so complete as to make this book an excellent starting point for students yet an equally valuable addition to the bookshelves of men whose business is transacted by way of the waters of the tidal Thames.

E.W.K.

" Timber Preservation." A new booklet published jointly by the British Wood Preserving Association and The Timber Development Association, has recently been issued. Single copies are obtainable without charge and post free from the B.W.P.A., 6 Southampton Place, London, W.C.1 or from the T.D.A., 21 College Hill, London, E.C.4.

Containing a complete list of proprietary wood preservatives and a table of preservative treatments for specific uses, the booklet provides a comprehensive source of reference to the whole subject of timber preservation. It has been prepared with the help and guidance of the Forest Products Research Laboratory and a number of architects, builders, chemists and engineers both in this country and abroad, through whose contributions it has been possible to bring a considerable body of knowledge and experience to bear upon the proper treatment of timber and plywood.

In the foreword it is stated that the growth of the wood preservative industry has been one of the most important technological developments within the timber trade and allied industries. The wide acceptance of preservation as an integral part of wood processing and utilisation has been a significant assurance of the continued use of what is the only structural raw material having a virtually inexhaustible source of supply.

Timbers of different species differ considerably in their durability. Practical experience through the centuries has shown which timbers give most satisfactory service under conditions favourable to decay and such timbers have established reputations leading to their employment where durability is desirable. It is not always economical or practicable, however, to use naturally durable timbers, hence the need for preservative treatment. Not all timbers are equally amenable to treatment and in order to investigate the problems involved in the proper use of preservation and preservatives, a joint committee of the Timber Development Association and the British Wood Preserving Association was set up with wide terms of reference.

The first task of the Committee was to establish agreement on basic principals. As a first step it was agreed that there were:

(i) Species amenable to preservative treatment;
(ii) Species not amenable to treatment;
(iii) Species of which the heartwood, though amenable, would not normally require treatment; and
(iv) Species, the sapwood of which would both require and be amenable to treatment.

Further, it was agreed that preservative treatment should be employed in conditions of use or service of which the following were considered typical:

(a) in contact with the ground; (b) at or below damp-proof course level in buildings and structures; (c) wholly enclosed in brickwork, concrete or masonry; (d) in any situation in which adequate ventilation cannot be provided; (e) in any situation in which equilibrium moisture content of the timber is likely to exceed 20 per cent.; (f) timber classified as of low durability, or with a fair amount of sapwood, and used in circumstances in which there is reasonable doubt of service conditions in regard to temperatures, ventilation and humidity; (g) in special cases in areas where fungal and insect attack is known to be prevalent; (h) where subject to attack by marine or other waterborne organisms.

Rubber in Engineering. Published by the Natural Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3 and available on request free of charge.

The Proceedings of the recent Conference on Rubber in Engineering, which was organised by the Natural Rubber Development Board, have now been published in book form. Bound in hard covers, " Rubber in Engineering Conference Proceedings " includes all five papers read at the Conference, together with the discussions they inspired, and has 160 pages and over 100 illustrations.

The five Papers comprise " Rubber must be used correctly " by W. J. S. Naunton, M.A. (Cantab), M.Sc., Ph.D., Dip. Chem. (Munich), F.R.I.C., V.P.I.R.I., Consultant on Rubber and Plastics to the Admiralty; " Load-Deflection Relations and Surface Strain Distributions for Flat Rubber Pads " by A. N. Gent, B.Sc., Ph.D., A.Inst.P., A.I.R.I.; " The Use of Rubber in Heavy Engineering " by S W. Marsh, M.I.Lo.E.; " Dynamic Fatigue Life of Rubber Components " by P. W. Turner, M.A., B.Sc., A.I.R.I. and " Rubber in Agriculture " by S. J. Wright, M.A.

All the papers emphasise that rubber must be correctly compounded, processed and vulcanised for the purpose in hand; it must be correctly designed for the unit in which it has to function; and it must be used correctly during its life.

" Ports of the World." Published by the Shipping World, Ltd., Effingham House, Arundel Street, London, W.C.2. Price 80/- post free.

The 11th edition of this very comprehensive book has recently been published and has again been revised and expanded. Details are given of accommodation, facilities, charges, repairs, pilotage, towage, bunkers, officials, etc. and the line drawings showing the layout of certain oversea and United Kingdom ports, which were first introduced in the ninth edition, have been retained and further developed. The contents also include a set of distance tables, a directory of liner services from United Kingdom ports and a table of foreign and colonial currencies.

Throughout the years of its existence, this book has proved its value to the shipping industry. Reports from some 2,000 correspondents make it the most up-to-date reference work of its kind.

" Port of Leith Handbook." Published by W. A. Woolward and Co., George St., Edinburgh, for the Leith Dock Commission.

This attractive and well illustrated handbook gives a description of the harbour, docks and auxiliary services of Leith and includes a scale map of the port area. The schedules of rates and charges are clearly laid out and afford a handy reference for shippers, agents and others associated with the port's traffic.

Miscellaneous information includes sections on Leith Chamber of Commerce, banking, insurance, shipowners and shipping agents, shipbuilding and engineering, and the grain, coal, fish, timber, wine and spirit and paint industries which form the port's principal trades.

Improvements at the Port of Geelong.

The Port of Geelong has started a £2 million reconstruction programme at Corio Quay north. The old North Berth No. 1 has been demolished and two new berths totalling 1,200-ft. are being built on the site. One of the new berths will be for general cargoes. Three 6-ton grab cranes costing £200,000 will be installed and rail lines connecting the quay with Geelong railway station will run the length of the berths.

Pneumatic Breakwater Experiments in Japan

Summary of Conclusions from Further Full-scale Tests

The principle of a pneumatic breakwater was developed half a century ago, in 1906, by an American, Mr. P. Brasher, but the method remained unestablished because the mechanism and performance of wave reduction were not sufficiently clarified. In the following years, owing to the importance of the discovery, a great deal of research was carried out, without any significant conclusions being reached. Recently, since 1952, the problem has attracted renewed international attention and the results of many experiments have been published. Of these, a theoretical study by Sir Geoffrey Taylor and the experiments in a water tank by Mr. J. T. Evans in England are most authoritative. Readers of "The Dock & Harbour Authority" will recall that reports* of a number of these trials and experiments have appeared in the Journal from time to time.

In Japan, since 1952, a completely independent theoretical and water tank experimental study, assisted by two systematic full scale tests have been carried out. In our issue for April 1956 brief details were published of the first full scale test, which took place near the Iwojima Islands off Nagasaki Harbour and, in the Editorial columns of our July, 1956 issue, reference was made to the second experiment at Hajima Island, in the same area.

Two papers giving details of this second full scale test and summarising the results and conclusions reached by the Japanese so far have since been published in the Bulletin of the Research Institute for Applied Mechanics, Kyushu University, No. 9, 1956. The following is reproduced from the English abstracts of those papers.

Second Test under Natural Conditions at Hajima Island

During the period of the seasonal winter winds of 1955-1956 the second full size test of a pneumatic breakwater was carried out at Hajima Island off the harbour of Nagasaki, as the continuation of the experiment which was conducted at the Iwojima Islands in the preceding year. The linear dimensions of the installation were about twice that of the first trial, and the result was favourable beyond expectations.

When the first full size test was planned, what we were aiming at primarily was establishing reliable scientific data which could be used for subsequent study of the pneumatic breakwater and also in taking the first step towards its realization. As the objective of wave annihilation, therefore, we took the minimum wave length permissible for a full scale experiment, 15m, taking into account that the available air supply was 30 m³/min. In the experiment use was made of equipment with comparatively small dimensions using a perforated pipe of 30 m in length. This breakwater proved to have the expected performance, and not only did this fact suggest the possibility of a practical pneumatic breakwater but also enabled us to notice a few important factors only verified till then in measurements in a water tank: that is, the significance of turbulent viscosity in the mechanism of wave reduction, in other words, the role of the parameter ξ ($= Q\, g^{-\frac{1}{2}} H^{-\frac{3}{2}}$, where Q = the volume of air under one atmospheric pressure consumed per unit length of the air pipe, H = the depth of the air pipe, and g = the acceleration due to gravity) as well as the remarkable diffraction of waves at both ends of a breakwater.

In spite of its success, the first test was small in scale and accordingly the result of the experiment was not sufficient to be applied directly to the waves of the Japanese seacoast. It became desirable therefore to undertake the second full size test on the largest scale possible, taking into consideration the results from the water tank experiments and the theoretical study. This then is the background of our new experiment.

Design of new installation: The maximum air supply for this experiment, generated by the Mitsubishi Mining Co. of Hajima Island, was 150 m³/min, 5 times as much as the first test. Now, the performance of a pneumatic breakwater is a function of the parameter ξ, and the smaller ξ is, the better will be the performance. The breakwater was designed in such a way that ξ would have the same value as in the first test (in the actual wave reduction test, however, the air supply was reduced to about 1/2 of the maximum, so ξ became 1/2 of the previous value and the efficiency was markedly increased), and if the new accommodations would be designed similarly to the old one in the geometry, the ratio of the linear dimensions would be $5^{\frac{1}{2.4}}$ or 2. Thus the perforated pipe having the length of $5.5 \times 11 = 60.5$ m was placed at 16 m beneath the lowest tidal level, assuming the length of waves to be annihilated would be 30 m. These waves correspond to the wind of 7-8 m/sec in this district.

Perforated pipe: Holes of 2 mm in diameter were bored at the ratio of 47.6 holes per metre in an iron pipe, 5 inches in diameter, galvanized extremely carefully. Concrete blocks were placed at the bottom of the sea and the pipe was fixed upon them at the prescribed depth. In our design the pressure difference between the inside and the outside of the pipe was assumed to be 0.25 kg/cm² when the air consumption was 75 m³/min. Coefficient of contraction of the air jet when entering the water was assumed to be 0.44 according to the result of the first test. The injection performance was found to be subject to a slight change during about half a year.

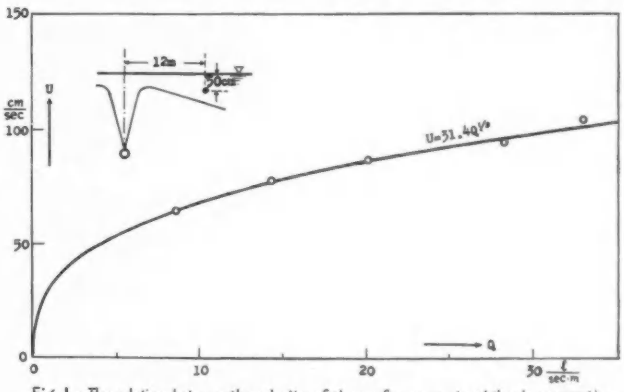


Fig. I.—The relation between the velocity of the surface current and the air consumption.

Wave recorder: Wave recorders, the same, in principle, as those in the preceding tests, were used. One was placed beside the pneumatic breakwater and the other in the protected zone (about 40 m behind the breakwater) in order to record the original and the reduced wave heights simultaneously.

Measurement of surface current: On a calm day the vertical and the horizontal velocity distributions of the surface current induced by air injection were measured by the same method as in the first experiment. They were also found, this time, to be of the same nature as was discovered in the laboratory. Further, the relation between the surface current and the air consumption was measured (See Figure I.) This is quite different from the preceding test and again has the same character as in the laboratory experiment, i.e., denoting the current velocity in m/sec as U, the air consumption in l/sec m (measured under one atmospheric pressure) as Q, the relation $U = 0.314\, Q^{1/3}$ was verified completely at the point 12 m distant horizontally from the breakwater and 50 cm from the sea surface, vertically, downwards. The region of all our experiments was from 0.39×10^{-4} to 1.56×10^{-4} with respect to ξ. This is smaller than the critical value (1.8×10^{-4}) below which the relation $U \sim Q^{1/3}$ did not hold in the preceding

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* Pneumatic Breakwaters by A. H. Laurie. May 1952.
Pneumatic Breakwater at Dover. December 1952.
Model Tests with Pneumatic Breakwaters by Prof. Walter Henson, Dr.Ing. June 1955.
Pneumatic and Similar Breakwaters by J. T. Evans, O.B.E., M.I.C.E. December 1955.

Pneumatic Breakwater Experiments in Japan—continued

test, and furthermore the current velocity corresponding to the same air consumption was found to be much increased. The increase in the efficiency of air bubbles is due, presumably, to that decrease of the size of each bubble compared with the first test, as observed with the naked eye, which became possible by assuming an appropriate value for the coefficient of air injection and by decreasing the pressure difference between the outside and the inside of the pipe.

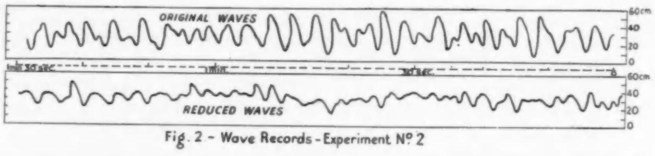

Fig. 2 - Wave Records - Experiment No 2

Wave reduction tests: Nine tests were carried out in all, but wave recording was possible in only five of them. The spectral analysis has not been completed, but two typical cases are described below.

Experiment No. 2. Wind velocity 7 m/sec, the depth of the perforated pipe 16.1 m, air consumption 19.0 1/sec m, power 1.85 kw/m (with regard to the flow of air bubbles immediately after the injection from the perforated pipe). Light wind and stable waves were very convenient for observation. The waves, advancing at an angle of about 30°, consisted of comparatively simple components and the annihilation of the waves could be noticed sufficiently well with the naked eye. The pipe was long enough compared with the wave length; the diffraction of waves at both ends of the pipe was not noticeable and the sea surface was calm over a large area. Comparing two wave records, the original and the reduced, taken before and after the air injection, we can conclude that the waves, at least up to 4 sec in the period (25 m in length), were practically annihilated. (See Figure 2.)

Experiment No. 3c. Wind velocity 8 m/sec. the depth of the perforated pipe 15.6 m, the air consumption 17.5 1/sec m, power 1.68 kw/m. The waves had complicated constituents, among which components of longer and shorter period advanced to the breakwater with angles of about 45° and 90°, respectively. So, excepting the components less than 3 seconds and choosing the one third highest waves in the records (in which the original and the reduced waves were measured at the same time), the mean wave height and period were calculated as below:

	mean height	mean period
original wave	96.4 cm	4.42 sec
reduced wave	66.3 cm	4.67 sec

reduction ratio = 0.69. Considering that the wave fronts were inclined to the breakwater and that the diffraction at both ends of the pipe was quite great leaving the protected zone sensibly disturbed as observed with the naked eye, it is supposed that this reduction ratio was only apparent and in reality our installation should have had a better performance.

Now that some of the quantitative data, although not necessarily sufficient, of a pneumatic breakwater has been obtained over a wide range of physical conditions, it is appropriate to summarize, in a general way, the results of our research about the physical mechanism and the performance of wave annihilation. For the sake of uniformity, we shall discuss the problem on the basis of the data so far obtained.

First, the history of the study of a pneumatic breakwater is surveyed from the view point of the physical mechanism of wave reduction. If we compare the wave length vs. power relation in the water tank experiments or the full size tests with the theoretical least power P predicted on the basis of the wave stopping action of the horizontal current namely

$$P = 0.002\,\lambda^{2.5},\ (P: \text{kw/m}, \lambda: \text{m}) \quad . \quad . \quad . \quad (1)$$

we shall find that, in spite of the remarks of Sir Geoffrey Taylor, the wave stopping action of the horizontal current induced by the bubble jet, important as it is, would not be sufficient to explain all the phenomena completely, and that we have to take into account the turbulent viscosity accompanying the water flow in an actual pneumatic breakwater. Thus two cases can be enumerated: the case when the wave stopping action is predominant and the eddy viscosity has the secondary effect of modifying the former, and the alternative case when the parts of both are reversed.

Outline of the mechanism of wave reduction: Roughly speaking, the mechanism of a pneumatic breakwater is analysed into a jet of air bubbles and the current induced by it. We shall denote by Q the volume of air under one atmospheric pressure ejected in unit time from the unit length of the perforated pipe placed at the depth H in water. Writing U and w for the representative velocity of the induced stream and terminal velocity of bubbles respectively, from the dimensional consideration we obtain

$$U = (gQ)^{1/3}\,\Phi\left(\xi, \frac{H}{H_o}, \frac{w}{\sqrt{gH}}\right), \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\xi = Q/g^{1/2}H^{3/2}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where H is one atmospheric pressure expressed in water column. The nondimensional parameter ξ varies as the 3/2th-power of the total volume of bubbles contained in unit volume.

Let us first suppose that the stopping action of the horizontal current induced by the bubble jet be the predominant factor of wave annihilation. If U is the speed of horizontal current, H its thickness and r is the reduction ratio of wave height when the waves (phase velocity $= c$, wave length $= \lambda$, wave height $= h$) enter the horizontal stream, it must be that $U/c = f_1\,(H_1/_2, h/_2, r)$. The power of the horizontal current P_1, therefore, summing up forward and backward directions, is given by

$$P_1/\delta g^{3/2}\lambda^{5/2} = (1/2\eta)^{3/2}\,\frac{H_1}{\lambda}\,f_1^{\,3} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The right hand side has a minimum in the region when H_1/λ is small. If the minimum value is calculated theoretically, equation (1) is obtained for the case when the current velocity decreases linearly. This equation, together with the assumption that the loss of the bubble jet might be just cancelled by the gain in wave reduction of turbulent viscosity, was proposed by us in 1954 as the standard formula predicting the power of an actual pneumatic breakwater.

If, on the other hand, the turbulent viscosity becomes the chief agent for the wave reduction and the horizontal current acts secondarily, the power of the compressed air per unit length is given by

$$P/\delta g^{3/2}\lambda^{5/2}\frac{H_o}{H}\,log_e\,\frac{H \times H_o}{H_o} = C(r)\,.\,(\frac{\lambda}{H}^{5}\,.\,\frac{(H/l)^6}{(\varphi\Phi)^3} \quad . \quad . \quad . \quad (5)$$

$$= C(r)\,.\,\xi^{2/3}\frac{H/l}{\varphi\Phi}\ , \quad . \quad . \quad . \quad (6)$$

where 1 is the representative length of the flow system. As long as ξ is not so large, according to the theoretical culculation, $\varphi\Phi$ varies only slightly in the range of our experiment.

In equations (4) and (5), the depth of the perforated pipe has the opposite effects. Namely, if the stopping action is predominant, the depth of the perforated pipe must be appropriately small in order to increase the efficiency which has been verified by Evans experimentally, but on the contrary if the turbulent viscosity is more important than the horizontal current, the pipe must be placed as deep as possible within the limits above which the efficiency of the bubble jet is so decreased.

Flow performance of bubble jet: The data used in the following discussions are drawn from the two full-scale experiments described above and also from the earlier preliminary experiments which were reported in Bulletins No. 5 and 7.

Denoting by U the maximum surface velocity, U/Q can be calculated as shown in the following table.

Table 1. $U/Q^{1/3}$ (flow performance)

	$U/Q^{1/3}$	range of U cm/sec	range of Q 1/sec m	range of $\times 10^{-4}$	depth m	bubble w cm/sec
(*a*)	29	30 ~ 50	1 ~ 5	4 ~ 20	0.8	23
(*b*)	29	(34) ~ 70	(5) ~ 18	(0.5) ~ 2	9	cap shape
(*c*)	33	(13) ~ 29 ~ 50	(0.15) ~ 0.5 ~ 3.5	(0.81) ~ 2.7 ~ 19	0.7	23
(*d*)	36.8	75 ~ 120	9 ~ 33	0.39 ~ 1.56	17.3	23 ~ 25

Pneumatic Breakwater Experiments in Japan—continued

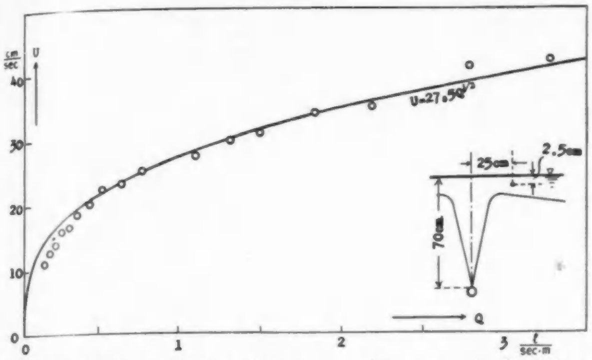

Fig. 3.-The relation between the velocity of the surface current & the air consumption. Water-tank test, 1955

The relation $U \sim Q^{1/3}$ holds good generally, only when w/U approaches unity the law suddenly ceases to be valid, so when ξ becomes smaller than a certain critical value ξc corrsponding to $w/\sqrt{gH}$, this proportional seems suddenly to break down and the flow performance decreases remarkably. When $\xi > \xi c$, the smaller is $w/\sqrt{gH}$, the greater is supposed the value of $U/Q^{1/3}$. When we compare the value of $U/Q^{1/3}$ (U: cm/sec, Q: l/sec m) shown in Table 1 with the value 41, which is the maximum value for a bubble jet obtained from the study of heat convection by Schmidt, we can conclude that the performance of a bubble jet is generally excellent provided that we take care that the bubbles do not become cap-shaped. Also when the depth of the perforated pipe is great and the volume of an ascending bubble experiences a marked change, it is interesting that the flow velocity on the surface is determined invariably by Q, the volume of air consumption measured under one atmospheric pressure. (See Figure 3.)

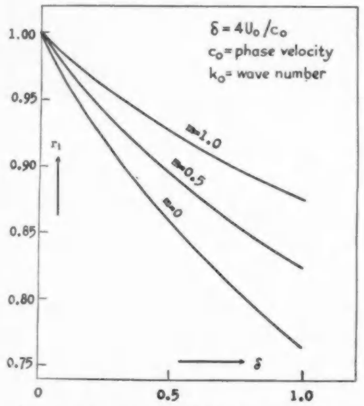

Fig. 5.-Reduction of wave height in the protected region by the following current, when the velocity decreases linearly from U_0 at the surface to zero at the depth l/mk_0.

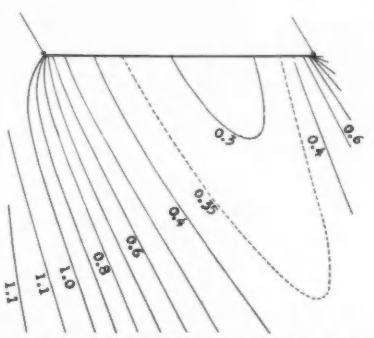

Fig. 6. Theoretical statistical mean height of the diffracted waves at the ends of a pneumatic breakwater, its length being 3-times of the wave length, the inclination of wave fronts = 30°.

The efficiency of bubble jet: Comparing P, the power of the bubble jet immediately after ejected from the perforated pipe, with P_1, the power of the horizontal current induced by the bubble jet in two directions, forward and backward, we can define the efficiency of the bubble jet conceived, so to speak, as an equipment generating water current. If we calculate this value from four tests, the following table can be obtained.

Table 2

	Q l/sec m	U cm/sec	H m	thickness of the layer m	P_1 kw/m	P kw/m	efficiency η %
(a)	1.63	40	0.8	0.20	0.0032	0.0128	25
(b)	12.2	71	8.3	1.30	0.114	0.75	15 (11)
(c)	3.4	53	0.7	0.18	0.0067	0.023	29
(d)	20.1	100	16	3.30	0.92	1.91	48 (29)

The maximum value of the efficiency of the bubble jet is 48% as known from the property of heat convection, accordingly the efficiency shown in Table 2 may be said to be excellent. The high efficiency in the full scale test is due to the compressibility of bubbles, and subtracting this contribution, the values given in brackets are obtained. If there is a wall in the neighbourhood of the bubble jet, some correction for its effect will be necessary.

Characteristic curve of wave reduction: power coefficient of wave reduction: Plotting the reduction ratio r on the ordinate corresponding to λ/H on the abscissa and ξ the parameter, the family of characteristic curves of wave reduction of a pneumatic breakwater is drawn (Figure 4). From these, η_o, the power coefficient of wave reduction for the given r and λ/H can be known as the function of ξ. Namely,

$$\left.\begin{aligned} \eta_o &= P/\lambda^{5/2}\frac{Ho}{H}\log_e\frac{H+Ho}{H_o} = a\xi\Lambda^{-5/2}(\gamma,\xi), \\ \lambda/H &= \Lambda\,(\gamma,\xi), \text{ (P } in\ kw/m;\ \lambda,\ \text{H, H}o\ in\ m) \end{aligned}\right\} \quad . \quad (7)$$

These two relations are the fundamental formulae for the design of a pneumatic breakwater.

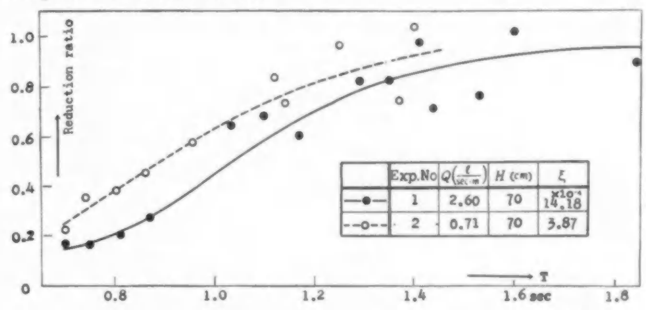

Fig. 4. Characteristic curves of wave reduction. Water-tank-test, 1955.

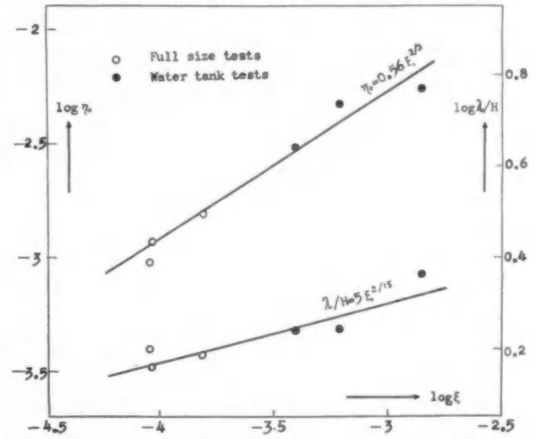

Fig. 7.-Power coefficient (η_o) of 50% reduction and ratio of wave length to the depth of a perforated pipe as function of ξ.
$\eta_o = P/\lambda^{2.5}\frac{Ho}{H}\log_e\frac{H+Ho}{Ho}$, P in kW/m, λ, H in m.
$\xi = Q/g^{1/2}H^{3/2}$, Q, g, H in C.G.S

With regard to the wave annihilation tests, we have at hand six comparatively reliable, sets of data collected from the water tank experiments and full scale tests mentioned. above, In order to compute from these data the wave reduction performance of a pneumatic breakwater, when tentatively 50% reduction is defined as the standard, we have to know the value of true reduction ratio from the value obtained directly from the wave records. For this purpose the method of correction by theoretical calculation is proposed for the reduced wave height in the protected region both by the horizontal current and by the diffraction of waves at the ends of the pneumatic breakwater. (See Figures 5 and 6.)

If the measured points are plotted with respect to ξ on the

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Eglinton Dock, Port of Ardrossan

Description of Entrance Widening Works

Eglinton Dock was constructed as part of the Harbour system at Ardrossan in 1890 at a time when the hulls of ships were shapely things and of smaller beam than they are now.

Ships entering Eglinton Dock pass from the Tidal Basin through an Entranceway 100-ft. long within which double-leaf gates are installed to maintain 28-ft. depth of water in the Dock.

Until the recent operation of widening the Entranceway, ships of beam exceeding 53-ft. could not enter the Dock owing to a restriction caused by the batter of 1 in 12 on the face of the side walls which reduced the effective waterway from 59-ft. 6-in. at cope level to 53-ft. 6-in. at gate cill level.

The work recently completed and described below consisted of removing the batter from the side walls so that the Entranceway was opened to ships of 57-ft. beam. While the gain thus obtained was comparatively small, the extra 4-ft. made the Dock available to a considerably greater range of larger ships including ore carriers, to deal with which the Port is particularly well equipped in craneage and railway capacity.

Records of the old wall structure were not obtainable but some information was found in a paper submitted to the Institution of Civil Engineers by the Consulting Engineer of that time, the late J. E. Harrison, M.I.C.E. (I.C.E. Minutes of Proceedings Vol. CXX —1894-5 Part II).

This information did not however detail the walls which were known to be of concrete with displacers of unknown material or size.

The Dock had to be kept open for shipping at all times and operations proceeded under the following restrictions:—

(a) all equipment to be portable for rapid clearance for the frequent passage of ships

(b) explosives banned because of the proximity of the dockgates and the drainage culverts which are located immediately behind the gates, and

(c) diving work to be kept to minimum.

The total height of battered walls to be dealt with, from quay level to cill, was 36-ft. of which 16-ft. was accessible at Low Water Springs.

The method devised was to cut back to the vertical the upper 16-ft. by ordinary mechanical chisel so that a ledge about 20-in. wide was formed just above the level of Low Water to serve as a platform from which drilling of the underwater part of the walls would commence.

The drilling gear, consisting of hand controlled sinker drills, was mounted at quay level on cantilevered platforms which could be retracted when large ships were passing. The Bill of Quantities allowed for 4½-in. dia. holes at 3-ft. centres to accommodate the hydraulic cartridge (buster holes) and intervening control holes 2½-in. dia. at 6-in. centres to be drilled vertically 20-ft. deep to cill level.

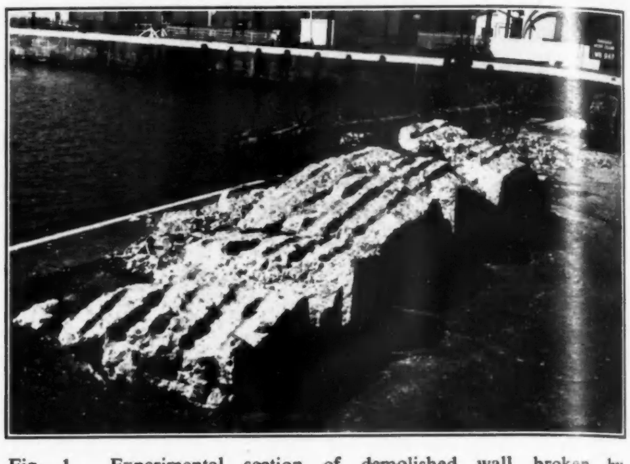

Fig. 1. Experimental section of demolished wall broken by hydraulic cartridge, showing clean drill holes where material is homogeneous concrete.

Fig. 2. Irregular shaped pieces of concrete broken by hydraulic cartridge—some pieces weighed up to 2 tons.

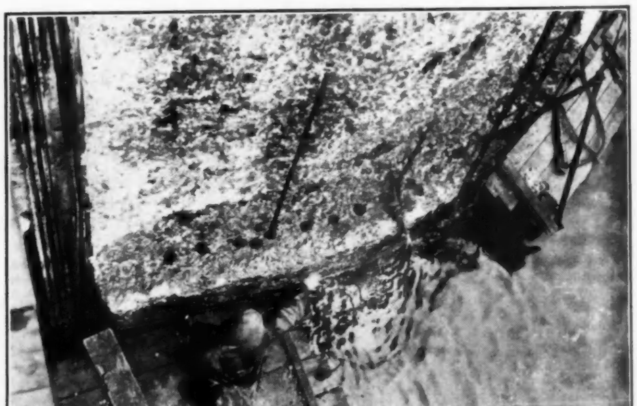

Fig. 3. "Buster" holes, 3½-in. diameter at 9-in. to 12-in. centres on working ledge at low water. The holes are drilled 20-ft. deep to cill.

Pneumatic Breakwater Experiments in Japan

(Continued from previous page)

abscissa and η_0 and λ/H on the ordinate, a curve with comparatively little dispersion is obtained. The values of φ and Φ in equations (5) and (6) are not subjected, according to an unpublished theoretical computation, to sensible change in the extent of our experiments. If we assume, therefore, that the linear dimension of the horizontal current induced by the bubble jet varies as the depth of the perforated pipe, the relations $\eta_0 \sim \xi^{2/3}$, $\lambda/H \sim \xi^{2/15}$, can be derived from these equations. (Figure 7.) If we determine the constant of proportionality in such a way that the above experimental results are best approximated, we obtain

$$\eta_0 = 0.56\xi^{2/3}, \qquad \lambda/H = 5\xi^{2/15} \quad . \; . \; . \; . \; . \; . \; . \quad (8)$$

Fortunately, equation (8) gives a good representation of the results of our meaurements. This fact suggests to us that in a case when a pneumatic breakwater is of some use, namely with a wave reduction of, say, 50%, the eddy viscosity plays the important part in the wave annihilation and the horizontal current acts magnifying the effect of the former. And the less ξ becomes, the more the efficiency of a pneumatic breakwater is increased so long as the efficiency of a bubble jet is not markedly deteriorated. Further the length of a pneumatic breakwater should be more than three times the wave length in order to reduce the effects of diffraction from both ends of the breakwater.

The above considerations are developed on the less reliable preliminary measurements and tentative spectral analyses of the full scale experiments, and therefore have to be checked and corrected, making use of the results of the water tank experiments and full scale tests which will be carried out in future.

Eglinton Dock, Port of Ardrossan—continued

As a rule three drills worked simutaneously supplied by air plant of 600 cu. ft. per minute capacity.

An opportunity of trying out the method before the main work was undertaken provided results which made the whole operation seem likely to be very rapid. Double recesses for stop-log coffer-dams in the Entranceway offered a 3-ft. wide experimental section of wall open on both sides. One "buster" hole and two control holes on each side of it were drilled and on pressure being applied from the hydraulic cartridge the concrete broke away in large cubical pieces. Fig. 1 shows the experimental section of dislodged concrete wall varying from 18-in. to 36-in. thick and 20-ft. in length pieced together after breaking with the hydraulic cartridge.

The result was however misleading as progress on the main walls was retarded due to various causes such as

(a) drills having penetrated to the thicker portion of the wall on occasion encountered displacers of freestone in which they were inclined to bind, requiring release holes to be drilled alongside.

(b) whereas the concrete generally cut cleanly under the cartridge, the stone displacers were inclined to fracture at an angle making the start of further drilling difficult on the sloped face. In such cases the diver had to cut a level base so that the drill head might enter again.

(c) the continuous wall without side cuts as at the stop-log recess made it difficult to control the sizes of pieces removed. From time to time pieces up to 8-ft. x 6-ft. and weighing up to 2 tons were removed in one operation (see Fig. 2).

(d) drilling time for "buster" holes was a little longer than that for control holes but the larger hole could be used if the need arose to accommodate the hydraulic cartridge.

It was soon found that holes of 3½-in. diameter were adequate and that the most effective interval between holes was 9 to 12-in. The holes were drilled to the full depth of 20-ft. to the cill in one operation before the cartridge was operated, any debris entering the hole before the wall was entirely cut down being either ejected by air or the drill reinserted (see Fig. 3).

"Gullick" Hydraulic Cartridges in twos and threes were inserted into adjacent holes to a depth of about 2-ft. 6-in. and pressure was applied manually, the dislodged pieces falling into a massive wire basket (made from steel tube frame and submarine netting) which was suspended by crane below the operators. Steel shims were inserted in the drill hole to cover the cartridge pistons and so ensure an even distribution of pressure on the concrete to be dislodged, and to protect the pistons at the same time.

The working tolerance for the finished face of the walls below Low Water was $\pm$3-in. which was found to be quite practical calling only for removal by diver of some of the concrete which projected between drill holes.

The walls above Low Water received a 2-in. thick coating of gunited cement mortar. Thereafter greenheart fenders were fixed.

In all some 4,200-ft. of 3½-in. diameter holes were drilled in the dock wall in a period extending to about 9 months, without impeding or interrupting the movement of shipping in the Port.

Cost of drilling was 11s. 8d. per foot and of breaking-out concrete 80s. per cubic yard. The total cost of some £15,000 for widening the Entranceway reflects the economy of the method employed.

The method of drilling and hydraulically dislodging the wall face all from quay level is believed to be quite novel. It was carried out by Messrs. Kinnear Moodie & Co. Ltd., Glasgow, under the direction of Messrs. Crouch & Hogg, Consulting Civil Engineers to the Harbour Company.

Cargo Ship Loading

Analysis of Methods at Selected U.S. Ports

The Maritime Cargo Transportation Conference (M.C.T.C.) of the National Academy of Sciences—National Research Council, Washington, U.S.A.—is engaged on a number of studies concerned mainly with the economic handling of cargo and the quick turn-round of ships. The most recent study, the fifth, has just been published under the title "Cargo Ship Loading," and includes (a) an analysis of the loading process at six U.S. ports and (b) the conclusions drawn from the data collected. The latter, which was based on the study of handling U.S. services material as well as commercial cargo, will be of interest to port operating organisations all over the world and are therefore reproduced below.

The study's practical use is that it (1) suggests improvements, where the present system of package-by-package handling must be continued and (2) points to the advantages of introducing alternative systems, where such would be possible. The report states, in fact, that if other systems could be employed, gains of greater magnitude could usually be reaped.

In introducing its conclusions, the M.C.T.C. states that "A careful study of loading operations in various ports reveals that the primary way of reducing direct costs without a major change of system is to improve the productivity of the longshore gang. Consequently," the report continues, "specific conclusions are divided into two groups, the first and most important group dealing with methods for improving longshore loading productivity, and the second dealing with the relationship of productivity to direct cost.

"It is axiomatic that a study of longshore productivity for loading different types of cargo in various ports will be meaningful only in cases where the cargo handled is similar with regard to the stowage factor, weight, cube, and shape of the individual units. Consideration of the peculiarities in handling all of the different types of special commodities encountered in different ports is an interminable task which has not been attempted. Instead, the study concerns itself largely with the loading of packaged items. In all ports examined, these items of cargo are delivered to the hold in quantity by a married fall and then individually stowed. This break-bulk system of handling packaged cargo has been found to be a major problem common to all ports and will probably continue to be so for some time to come. Longshore productivity in this operation has been found to be considerably lower than in handling those special commodities susceptible to rapid handling.

"It is not the intention of this study to consider the merits of systems of handling cargo other than the current break-bulk method. The study demonstrates, however, that while considerable improvements in the present system are possible, other handling systems must be sought for gains of larger magnitude.

"The following conclusions on loading productivity pertain only to East and Gulf Coast operations.

Conclusions on Break-Bulk Loading Productivity.

1. The present system of loading general cargo is being operated for the most part well below the capability of the mechanical equipment and manpower employed.

2. Although technical means for correcting system inefficiencies are available and undoubtedly known to the controlling human elements, these means have not generally been employed.

3. In all loading operations observed, the hook is the primary bottleneck. Contrary to the sampled opinion of industry officials, the hold section of the longshore gang is not the bottleneck since it is idle over 40 per cent. of the time waiting for the hook to deliver cargo.

4. In most operations observed, the hook is not being used at maximum capacity to deliver cargo to the hold. This inefficiency is primarily due to insufficient draft size and unnecessary delays in the hook cycle. It does not result either from inadequacy of the pier apron to feed cargo to the hook or from mechanical limitations in the gear.

"The following improvements to the hook operation promise gains in the loading rate up to 50 per cent. in terminals where operation of the hook is least effective and where a 12-man hold gang may be used:

(a) Increase the size of the cargo draft, within the limits of safety.

(b) Develop and employ special devices for the handling of uniformly packaged commodities, such as drum chime hooks and bale tongs. Such devices should have the effect

Cargo Ship Loading—*continued*

of reducing avoidable delays to the hook while picking up the load at the apron and releasing it in the hold.

(c) Insure that the winches are operated so as to minimise the hook transit time.

(d) Reduce hook delays introduced by draft spotting which involves swinging of the load into position by the hold gang This may be accomplished by installation of ship cranes or by modification of the burtoning system so as to facilitate spotting of the draft, as is the intention of Ebel and Farrell burtoning systems. Improvement in the hook cycle may also be achieved by development and more frequent use of stowing devices such as wagons, dollies, conveyors, and fork-lifts. Such devices should tend to make the hold gang less dependent on spotting as a means of reducing the distance between the position where the hook places the load and where the load is ultimately stowed. This would release the hook to perform its primary function of delivering cargo to the hold.

5. When the hook operation is the bottleneck, use of more men in the hold or of any devices which improve only hold gang stowing productivity will not increase over-all loading productivity significantly. However, devices which reduce fatigue and improve hold working conditions may be highly desirable for longshore morale and safety reasons.

6. In all observed loading operations, whether at modern or outmoded terminal facilities, there is no indication that the terminal has induced delays in the delivery of cargo to the hook so that the loading operation was slowed to a significant extent (more than ten per cent.). This is not intended to imply that poor terminal facilities might not have a more adverse effect, percentagewise, if loading rates are improved; nor is it intended to imply that these facilities should not be modernised for other reasons.

7. When and if the hook ceases to be the bottleneck, over-all break-bulk loading productivity could be increased signficantly by improving hold gang productivity through adoption of the following measures:

(a) Employ at least 12 men in the hold gang when stowing units which are susceptible to manhandling; the point of diminishing return, however, is undetermined.

(b) Develop and utilise mechanical devices which accelerate stowing operations and reduce fatigue in the hold. Particularly, improve time-consuming operations involved in loading least accessible hatch wing regions. This may be achieved by development and use of wing stowing devices or by changes in ship design which make wings more accessible.

8. The effects of hold-gang fatigue on productivity are apparent as the proportion of hold gang work time to operating time increases. However, fatigue is not a limiting factor at work time percentages below about 60 per cent. Most data lie in this area.

9.—Under similar conditions, the work rate achieved by the members of the hold gang, while actually working, does not vary significantly from port to port.

10. With present ships, net[1] gang-hour break-bulk loading rates of about 50 to 105 measurement tons per hour, depending on general cargo package types, may be obtained by use of improvements suggested in 4 and 7. Where these improvements are already incorporated into the system, for example in the loading of certain types of cargo in New Orleans, these rates have been attained.

11. With all foreseeable cargo handling improvements including optimum ship designs, the break-bulk loading operation still would be limited by the process of handling individual items in the hold. Depending on the nature of the cargo, the process will permit **at most** loading rates from four to eight per cent. greater than are attainable as indicated in conclusion 10 with present ships and present cargo handling gear (assuming a 12-man hold gang). Postulating an adequate hook delivery, some gains may be possible through use of a hold gang of more than 12 men. However, beyond this, promise of a significantly greater improvement in productivity can come only from new systems which eliminate the current break-bulk process in the hold.

[1] Net gang-hour refers to time spent in loading only. The time consumed in dunnaging, rigging, gear changing, and housekeeping functions is not included.

Conclusions on Loading Costs.

1. The total cost of loading a vessel (either partially or completely) varies inversely with observed net loading rates per gang hour. Eighty-two to ninety-two per cent. of this cost is dependent on loading time. Thus, total cost at a net loading rate of 70 measurement tons per gang hour is about one-half that at 35 measurement tons per gang hour.

2. Differences in labour practices among ports affect total loading costs noticeably. For example, at some ports total costs could be reduced by as much as five per cent. if less work time were lost because of excess time-off for lunch, early quitting time, etc.

3. Judicious use of overtime reduces costs of loading by as much as five per cent. in ports with higher wage rates and by as much as ten per cent. where wage rates are lower."

It will be seen that, at the ports studied, packaged cargo was always delivered to the ship by married fall and was always handled as individual packages. In paragraph (3) above, it is mentioned that the hook was the primary bottleneck; in paragraph (4), that hook delays could be reduced by the swinging of the load nearer to the stowage area by the hold gang. At crane ports, the need referred to in (4) is obviated by the very presence of quay cranes; and at ports, e.g. London, which employ dock-tool pallets at their export berths, it is not the hook but the stowing of cargo in holds which is the bottleneck. Loaded pallets can always be brought to the quay alongside the appropriate hatch as quickly as the men in the ship can cope with them. Moreover, the pallets measure 54-in. x 72-in. and are always given a full load.

The conclusion in paragraph (7) that time may be saved by changes in ship design, supports the opinion of other organisations which have studied this particular subject. This subject will be, in fact, discussed in an article entitled "Cargo Handling and Ship Design" in the September issue of this Journal.

The last point made by the M.C.T.C. in this study (paragraph 11) is that promise of a significantly greater improvement in productivity can only come from new systems which eliminate package-by-package handling in the hold. The trailership system (the subject of one of the M.C.T.C.'s recent studies), which was described in our June issue, and the ramped-craft system of transporting lorries loaded with cargo (such as is employed in a service between England and Northern Ireland), have already been evolved as alternatives to package-by-package handling. For general cargo vessels, however, the alternative to loose goods is probably unit loads and the development of this method of handling and transporting needs the co-operation not only of the stevedoring organisation, but often also of the manufacturer, the packer, the shipper, the transport agent (road and/or rail), the port authority, the Customs authority and the shipping company. It is very often difficult to get all these interests together with one purpose in mind!

Improved Passenger Accommodation at Southampton.

Work is shortly to commence on the provision of improved passenger facilities at the south end of Berths 30/31, Southampton Docks. Royal Mail Line vessels regularly use these berths and the accommodation is also used by many other ships trading to all parts of the world. The new accommodation will occupy the site of the present passenger hall, which will be demolished, and will serve not only berths 30/31 but the adjacent shed No. 32/33, where the existing waiting room will be removed. When in use by passengers embarking or disembarking at the adjacent shed a covered passageway will be provided between the two sheds to give protection against the weather.

The accommodation will comprise a main waiting hall, measuring 85-ft. by 65-ft., with Immigration Office, Shipping Company's stand, Money Exchange, a Control Room with public address system, Telephone Bay, Buffet, writing desks for the use of passengers, toilets and other amenities. There will be a combined system of concealed and direct lighting and heating will be by the Pyrotenax system with the elements built into the floor.

These new amenities will generally conform to the latest standards of passenger accommodation provided by British Transport Commission at Southampton Docks and should greatly facilitate the comfort of passengers.

Permanent International Association of Navigation Congresses

Review of XIXth Congress—London 1957

Introduction.

THIS review of the Congress proceedings is limited to the discussions of the eleven subjects on which more than 100 papers were presented. To deal with these subjects the Congress was divided into two sections. Section 1 on Inland Navigation was under the chairmanship of Mr. C. M. Marsh, B.Sc., M.I.C.E., Divisional Manager, N.W. Division, British Transport Waterways, and Section 2 on Ocean Navigation was under the chairmanship of Mr. G. A. Wilson, M.Eng., M.I.C.E., M.I.Mech.E., Chief Engineer, Port of London Authority One subject, "The Influence of Ice on Navigable Waterways," was considered jointly by the two Sections under the chairmanship of the Secretary-General, Mr. W. Mackenzie, B.Sc., M.I.C.E., Engineer (General Duties) of the Docks Management Board of the British Transport Commission.

Before studying the Sections individually, it is perhaps interesting to note that the term " navigation " in the titles of the Association and the sections does not have its normal connotation but refers to matters appertaining to docks, harbours and waterways.

SECTION I—Inland Navigation

This section dealt with three questions and three communications. The questions were:

1. The role of inland water transport.
2. The evolution of propulsion and control of single craft and trains of barges on rivers and canals.
3. New means of utilising the hydraulic energy of navigable waterways. Their interference with navigation and their influence on design and construction.

The papers presented on these questions came from the countries of Western Europe, the U.S.S.R., Hungary, Yugoslavia, and the U.S.A. and were all highly informative of the operational details of the various systems in each country. Delegates contributed in the discussion in Congress further details and commented upon the reports of the Reporter General in each case.

The role of inland water transport

The Section opened with a study of the role of inland waterway transport and its relation to other modes of transport with a view to furthering the economic development of the various countries and the Reporter-General for this first Question was Mr. M. J. Blockmans, Administrateur-Inspecteur Général des Services Maritimes D'Anvers, Belgium.

The consideration of Question I led to the general conclusions that except in countries in which all transport is in the hands of the Central Authority, inland navigation is continuing to be subjected, in general, to the competition of the railways and small boats of less than 100 tons seem destined to disappear mainly because of the evolution of road transport. Nevertheless it was agreed that though railways have freedom in fixing tariffs, inland navigation in private hands has been able to develop and keep pace in the transport of loose and very bulky goods. This stems from the low power consumption and the small labour force employed. To develop inland navigation it was thought that the replacement of small barges by boats of larger tonnage and further extensive motorisation of a fleet and the improvement of waterways by making them suitable for higher tonnages (in Western Europe as far as possible the 1,350 ton gauge) were important. In addition, the use of radar with a view to reducing stoppages due to bad visibility, and the lighting of navigable waterways and signalling by means of reflecting signs enabling navigation to be lengthened in the winter period were important and, with other means, could achieve round the clock operation of the great navigable waterways of Western Europe for certain types of traffic. A further way to develop inland navigation, it was considered, included the application where possible of the pushing technique with integrated trains of barges.

As regards the broader picture, the Congress accepted that provided Public Authorities voted the necessary supplies for modernisation, inland navigation must continue to develop and be an important factor in the economy, but the efficiency of the collective transport system of a country can only be obtained by really effective collaboration between the various methods of transport and this implies that each method is brought to a standard commensurate with modern techniques.

In the course of the discussion of Question 1, Mr. Verhay, Chief Engineer of the Central Rhine Commission provided valuable and interesting information of the productivity of various fleets based upon statistics and the reports presented. The productivity of a fleet Mr. Verhay expressed in t.km. per ton of fleet. The resulting figures expressed thus were:

U.S.A. (without lakes)	12,800 tkm/t
U.S.A. (lakes)	36,000 tkm/t
France	2,380 tkm/t
Rhine	4,400 tkm/t

These figures Mr. Verhay explained could not be properly compared without taking into account the conditions of navigation which are essentially different in each case. The figures do however explain the characteristics inherent in each fleet.

Propulsion and control of barges

Question 2 dealt with the evolution of types of propulsion and control of single craft and trains of barges on rivers and canals, comparing self-propelled vessels and others and the Reporter General was Maj-Gen. G. E. Galloway, Divisional Engineer, Missouri River Division, Corps of Engineers, U.S. Army.

The papers presented gave the history, development and experience of the country concerned and it was declared that the general trend has been to modernise the waterway equipment as new forms of propulsion have been developed as rapidly as economic conditions would permit. The methods of control of single craft have followed the evolution of propulsion methods very closely, i.e., from hand power to bank control to the present highly effective rudder systems of modern design.

On European waterways the predominant method of handling dumb barges is the traction towing method as compared to the push towing method predominantly used on U.S.A. waterways and the Congo. One of the principal economies resulting from push towing is the saving in operating manpower as compared to traction towing, this factor being more important on long waterways than on congested shorter traffic ways. On European waterways the self-propelled vessel appears to be gaining in favour over that of the former. The parallel to this trend on such waterways as the Congo and those of the U.S.A. is the use of streamlined or integrated tows which produces the advantage in speed without loss of flexibility of the dumb barge. In Europe, however, there is an increasing interest in the technique of " pushing."

Utilisation of hydraulic energy of navigable waterways

New means of using the hydraulic energy of navigable waterways and their interference with navigation and their influence on the design and construction of all structures concerned, with special regard to movable barrages (dams), were discussed in Question 3. The Reporter General was Mr. R. D. Gwyther, C.B.E., M.C., M.Sc., M.I.C.E., Coode and Partners, Consulting Engineers, London.

The papers presented to this question all indicated that the proper control of a river or navigable waterway is essential. Many interests are involved, flood and irrigation control, pollution by users and towns, power projects which affect navigation; these and

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other problems can only be satisfactorily surmounted by preliminary negotiations and consultations.

This is expressed in the first conclusion reached by Congress, namely, that all parties interested in the development of a waterway should co-operate in the preliminary stages and should agree on the final project.

Concerning the effect of power installations upon inland navigation the papers from Western Germany gave information on model tests (1:55) at the Jochenstein power station on the Danube. These tests were made on a model barge approaching upstream of the lock and were made to determine the effects of surges caused by varying the speed of opening sluices, throttling the turbine and increased flow through the turbines. In general the results indicated that the effects of surges can be overcome by a combination of turbine control and sluice lowering. Delegates in discussion gave additional information to that provided in the papers and in conclusion agreed that careful study should be made of the effects of a sudden shut down of turbines creating surges which might endanger shipping and the structures themselves. The various methods of reducing these surges could be advantageously studied on models.

Arising from the information given in the papers, it was also agreed that in rivers with small gradients it is often necessary for the improvement of navigation to accept small falls; modern types of generators (such as the "bulb set" described in a paper from France) enable these falls to be used for power production.

In addition to the Questions, three communications upon the following were also the subjects of discussion.

1. Means of dealing with large differences in head in order to facilitate the passage of vessels on inland waterways.
2. Means of making watertight the beds and dykes of navigable canals and rivers.
3. Influence of ice on navigable waterways and on sea and inland ports.

Means of dealing with large differences in head

The papers presented under Communication 1 all contained valuable information and experience of the problem of dealing with large differences of head in order to facilitate the passage of vessels on inland waterways. The Reporter General appointed for this was Mr. C. A. Wilson, M.I.C.E., Watford, England.

A paper from Czechoslovakia provided information of the factors, with particular reference to filling and emptying times, determining the design of large locks. A paper from France described the Fontinettes canal lift of 13 m. on the Newfosse Canal which in accordance with French policy has been designed to reduce locking time to a minimum. The paper also gave information of the construction of emptying and filling systems with varying differences of head involved. It also described scale model tests to determine the effect of different positioning and treatment of culverts by grouping. A paper from Spain described the development of the River Guadalquiver as a navigable waterway and the construction of regulation locks, locks and canals. A paper from the U.S.A. described filling systems employed there; the most favoured being longitudinal culverts in each wall with short lateral ports in the lock floor or conduits in the floor with short ports in their sides or roofs. Economy basins are not required in the U.S.A. as water supply is adequate.

The Congress endorsed the view expressed in the paper from Western Germany that the adoption of a lock or lift depends on soil conditions, on the availability of water and on the requirements of navigation, irrigation and power generation. All five papers featured the importance of the investigation of flow problems involved in filling and emptying of locks and in some instances gave details of the test equipment and methods employed. 1:25 is a scale generally employed for hydraulic tests and 1:20 for valve tests. Model ships have been employed in tests to study hawser pull. Model tests being generally recognised, the Congress summarized that it is always desirable to test on models alternative features of locks or lifts to ensure smooth hydraulic and mechanical operation.

Locking time being of financial importance—the U.S.A. paper stated that one minute saving in locking time represented 60,000 dollars when related to capital investment.

The Congress endorsed certain of the conclusions reached in the French paper that in design of locks or lifts the number of steps should be as few as possible. Further, as the height increases the capital costs of locks increases faster than that of lifts. Also, for a height over 30 metres, the advantage lies generally with lifts and there is no practical limit to the height of lifts.

Means of making watertight canal and river beds

The Reporter General for this Communication was Mr. J. T. Evans, O.B.E., B.Sc., M.I.C.E., British Transport Commission, Docks and Waterways Research Station, Southall, England. Nine papers were presented, covering the traditional ways of preventing leakage from canals, viz.: by clay puddle, concrete linings, reinforced or otherwise, vertical partitions formed by excavation or by injection and concrete, timber and steel sheetpiling. In addition other ways which are new or of recent introduction were described viz.: Bentonite either alone or mixed with clay, injection by chemical solutions (e.g. potassium silicate, and caustic soda) and by planned sedimentation, taking advantage of recent developments; bed layers of thixotropic materials laid in the dry; bored sheet piles cast in place and asphalt mats laid under water.

Influence of ice on navigable waterways

This Communication was considered jointly with Section 2 and the Reporter General was Mr. Johan Volkers, Hoofdingenieur van de Rijkswaterstaat, Heemstede, Netherlands.

Eleven papers were presented on this subject and dealt extensively with the problem. Reference was made, in the paper from Western Germany, to the well known fact that ice is formed on the surface of still water when the body of water has cooled down to 4°C. The surface ice, on account of its poor conductivity increases in thickness only very slowly and the amount of ice which forms is relatively small. In the case of running water there is no question of layer formation on account of the turbulence. Ice forms suddenly and occurs everywhere particularly where there are many nuclei of crystallization e.g. on the bottom and where substances are in suspension in the water. The quantity of ice formed is greater than when ice forms in still water.

The formation of a continuous sheet of ice is therefore regarded as the best means of preventing the formation of large quantities of ice.

The papers and the ensuing discussion covered other aspects of the problem viz. the factors affecting ice formation in sea ports, information on ice breaking and measures to be taken in protecting hydraulic works against damage by ice.

The paper from Sweden referred to a new method of keeping waterways free from ice by blowing compressed air through a perforated pipe laying on the bottom so that the warm bottom water is brought to the surface. The paper from the U.S.S.R. treated the subject extensively and discussed modern methods of collecting information on ice formation, by aerial reconnaissance and photography, radar and observation posts, to serve in ice control and breaking operations and forecasting. The paper also recounts the remarkable results achieved in combating the difficulties encountered in that country.

The discussion in Congress recognised the valuable use to which hot industrial waste water could be put and recommended that in the planning of large industrial establishments and power stations that due regard and study be given to the water intake and discharge to and from these establishments so as to use them in the best way to control ice formation; to reduce interruptions to shipping and to prevent flooding arising from ice formation.

SECTION 2—Ocean Navigation

Section 2 had two main questions to consider and three communications. The questions were as follows:

1. Methods to be taken to improve the handling of general cargo.
2. Berthage and handling of large oil tankers.

Cargo handling

A whole day was devoted to the discussion of the first subject, one, which the Duke of Edinburgh had stated was, in his opinion, the most important subject before the Congress. Its full title was

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"Measures to be taken for improving the handling of general cargo between the vessel and the storage installations on the quay or between the vessel and the means of inland transport." Papers were submitted by Western Germany, Spain, U.S.A., France, Great Britain, Italy, Japan, Holland, Sweden and the U.S.S.R. The Reporter General was Mr. Francis H. Cave, until recently General Manager and Secretary of the Mersey Docks and Harbour Board.

The scope of the subject and the variety of contributions, both in the papers and in the verbal discussions, render a brief resume difficult, but there was general agreement on a number of important aspects. Single-storey transit sheds were generally preferred but two-storey and on occasion multi-storey sheds may most economically meet special local requirements. Quay cranes were considered by most European contributors including those from U.S.S.R. to be not only desirable but essential in the interests of overall economy, efficiency, rapid turn-round and the optimum utilization of quays. The growing use of road transport is a wide spread feature and the need to recognize this in port planning was repeatedly stressed.

The problems associated with dock labour received considerable prominence. From the United States as well as many European countries came comments on dock workers' lack of understanding of and enthusiasm for new developments and the need for the ready co-operation of labour if a substantial degree of mechanisation were to become a reality. The need to realise the importance of good labour relations was urged.

It was, however, on the subject of the packaging and presentation of cargo that Congress found itself up against the most urgent, yet intractable problems. Mechanisation, palletisation, the marking and packaging of goods, the "unit-load" system, the "roll-on roll-off" system, container traffic, all the modern developments towards reducing the cost and time of handling general cargo came under review, and it was apparent that improvements depend not only on the efforts of dock engineers and operators, but on the general appreciation of the problems and concerted action by manufacturers, importers, customs and other bodies.

Finally the delegates unanimously recognised the need for international study and action and this recognition was given expression in the conclusions adopted by Congress in relation to this subject. These conclusions were:

1. That there is a need for ensuring on an International basis the continuous exchange of information concerning common problems with, if possible, agreement on single or related matters, aimed at facilitating cargo transportation.
2. In order to meet this need, the Congress requests the Executive Committee to set up an International Commission to study, in conjunction with other appropriate organisations where desirable, the following subjects:
   (a) the provision and full utilization of terminal facilities and appliances to ensure the speedy and economical flow of cargo;
   (b) improved methods of presenting general cargo for shipment by the utilization of existing and new techniques so that such cargo is made available in the most economical number of units;
   (c) the principles governing the co-ordinated design of ships and conveyors with terminal facilities and methods of presenting cargo;
   (d) problems relating to the marketing and packaging of individual items of cargo.
3. That consideration be given to methods of further developing the joint approach of port workers and employers to measures designed to improve cargo handling.

Oil Tankers

The second question considered was also allotted a full day. This dealt with the transportation of oil, the specific matters dealt with being "Berthage for large oil tankers; handling of their cargoes; pipeline layout and hose-handling equipment for loading and discharging tankers; provision for distribution by road, rail or smaller vessels; measures to be taken for ensuring safety; methods of preventing or reducing pollution of harbour waters; equipment for gas-freeing and cleaning the tanks of oil-carrying vessels." Papers were presented by representatives of Denmark, France, Great Britain, Italy, Spain, Sweden, the United States and Western Germany, and the Reporter-General was Mr. C. W. N. McGowan, M.A., M.I.C.E., M.I.Mech.E., Civil Engineer of the Kuwait Oil Co. Ltd.

In his report, the Reporter General drew attention to the continuing nature of many of the problems associated with the handling of oil tankers and their cargoes, some of the problems having been dealt with at previous congresses. He urged the need for much closer co-operation between harbour and shipping authorities on the future planning of ports, and it is apparent from the papers presented that the ever increasing size of tankers is creating a situation which demands the most careful consideration on national and international levels.

The main problem is the provision of berths and approach channels with sufficient depth of water to accommodate tankers whose average size was stated in one paper to be increasing at the rate of 1,000 tons deadweight per year. Of the 690 tankers on the world's order books in February, 1957, 621 exceeded 24,000 d.w. tons of which 150 were over 45,000 d.w. tons. An important aspect of tanker accommodation is the means adopted to absorb the impact forces arising during berthing, and many systems of fendering were described. The assessment of impact forces was treated both in papers and in the discussion at some length, and it was apparent that here is a subject that calls for the international exchange of observations and opinions. For example the view expressed by a Swedish author that the maximum kinetic energies likely to require to be absorbed would arise rather from tankers of 16,500 to 22,500 d.w. tons than from larger tankers was not universally accepted.

Many types of berths were described; the marginal berth, usually considered the best but frequently uneconomical in capital cost and space, the jetty either with alongside berthing or with a T head—the usual means of locating the berth in deep water, and dolphin and buoyed moorings with submarine pipelines for less dense traffic in less developed parts of the world.

It is evident that in this thriving industry rapid development and expansion is being matched by great efforts to overcome the associated problems, amongst which are oil pollution of harbour and coastal waters and safety against fire. Britain's lead in dealing with the former is widely appreciated, and the matter is receiving world wide attention. Safety precautions are constantly receiving national and international study, and activity of this nature was welcomed by Congress in the last of the three conclusions arrived at in connection with this subject. The conclusions were:

1. There is an urgent need for joint study on the part of tanker builders and operators on the one hand and Port Authorities on the other of certain problems relating to the maritime transport of oil.
2. To meet this urgent need the Congress requests the Executive Committee to set up an International Commission to study among other subjects and in conjunction with other organisations where desirable, the following subjects:
   (a) The impact factors involved in the berthage of oil tankers and the related design requirements;
   (b) The design and disposition of manifolds and hose-handling equipment both on the tankers and at the berths.
3. The Congress realises the need for continuing research on the following subjects:
   (a) Measures to minimise the pollution by oil or ballast of coastal and harbour waters;
   (b) Safety codes of practice for the prevention of fire at oil ports and storage installations and in oil tankers;
   (c) Ways for reducing turn-round time . . . . and requests the Executive Committee to support strongly other organisations more specifically concerned with the formulation and promulgation of appropriate international standards.

The three Communications were each allotted a half day for discussion and were upon the following subjects:

1. Origin and effects of long period waves in ports.
2. Maritime locks and graving docks (dry docks).
3. Siltation.

Navigation Congresses—*continued*

Long-period waves in ports

The first Communication dealt with the "Origin and effect of long period waves in ports; precautions to be taken for the safety of vessels; possibilities of minimising the effects; experiments using scale models." The Reporter General was Prof. J. Allen, D.Sc., F.R.S.E., M.I.C.E., of Marischal College, Aberdeen, Scotland. Papers were presented by Western Germany, U.S.A., France, Great Britain, India, Italy, Japan, Netherlands, Portugal and South Africa.

In his summary Prof. Allen pointed to the fact that during the past ten or twenty years research in this important field had been intensified and was now aimed at improving or extending the mathematical treatment; providing a more accurate and comprehensive picture of the wide spectrum of oscillations in the oceans, in shallow seas and in harbours; establishing the causes of the phenomena; predicting disturbances likely to cause damage or danger to shipping; studying the actual results of long period waves; and developing the design of suitable alleviating and remedial measures.

Although the number of major ports seriously affected by range action is comparatively small, it is a serious problem in some ports such as Cape Town and Madras. In such ports it gives rise to mooring difficulties and on occasions considerable damage to shipping may arise. The increase in silting which may be caused by seiches was referred to by the Dutch author. Storm surges leading to floods are manifestly of serious import.

The origin of range and surge effects are generally accepted as being either seismic or meteorological, but their generation and incidence are by no means fully understood. As Lord Waverley, President of the Congress, remarked at the final session, seiches were receiving intensive attention when he was a student in the University of Edinburgh almost fifty years ago, and indeed they began to be studied as early as 1828, but the need for more study, for a greater effort to establish sound observations and for fuller exchange of data and research findings was expressed by many delegates. To minimise the devastating effects of floods, the ability to forecast storm surges accurately was essential. With regard to range action the development of the mathematical treatment and the use of scale models was of great value, but the action taken to reduce the effects in harbours by re-alignment of entrances, and modifications in the length of breakwaters and other structures was to a large extent empirical and tentative. On these matters, on the oscillations of vessels and on many other related subjects, a great deal of work was still required.

Faced with this situation Congress finally recommended that the existing P.I.A.N.C. committee dealing with wave action should expand its terms of reference to include the following subjects:—

(a) the origins of long period waves so that their incidence may be forecast,

(b) the disturbances (for example the frequencies and amplitudes of waves) which can be tolerated in harbours,

(c) the mooring of ships in relation to such disturbances . . . . . . and made the point that the resources of the International Geophysical Year should be used in connection with the first subject.

It was also recommended that the mooring of ships in harbours should be considered as a subject for a future Congress.

Maritime Locks and Graving Docks

A subject of great importance and interest and one on which the contributions to Congress have greatly increased the documentation was "Maritime locks and graving docks—calculations and modern methods of construction; types of gates and caissons; stresses to which they are subject; designs adopted specifically for those which are exposed to swell." Western Germany, U.S.S.R., Denmark, the United States, France, Great Britain, Italy, Japan and the Netherlands contributed papers and the Reporter-General was Mr. J. H. Jellett, O.B.E., M.A., M.I.C.E., Dock Engineer, British Transport Commission, Southampton Docks.

The papers, as well as dealing in some cases with the general aspects of design and construction, provided a very considerable volume of information on specific structures. Indeed the Reporter-General is to be congratulated on a masterly summing up of the salient features, a task of truly Herculian proportions. As would be expected the contributors gave considerable prominence to the means used in overcoming difficulties related specifically to particular sites, regarding which no generalisations can be made, but certain themes ran through all the papers and were apparent in the discussion. These concern the design of dry dock and lock floors to resist or avoid hydrostatic uplift, the optimum type of gate and the design of the walls.

As regards the floor, the conventional method of providing sufficient thickness to resist uplift by weight is still widely employed as also is venting where uplift conditions are not so severe. In Germany and in France, however, thinner floors have been provided, tied down to firm strata by means of raking piles or prestressed cables attached to anchorages sunk into the underlying beds. The extension of dock floors beyond the side walls so as to make use of the overlying earth burden to help to resist uplift appears to be fairly common.

A number of different types of gates were described and the reasons given for their selection in particular conditions; sliding caissons, "ship type" floating caissons, rectangular floating caissons, "Box" gates and variations of this type, sector gates and others. There is abundant variation in the methods of providing stability, flotation, seals and maintenance accessibility. One aspect of this subject gave rise to some difference of opinion. The trend in Germany would appear to be away from three edge support for floating caissons (two sides and the cill) to two edge support, on the grounds of a reduction in the difficulty of design and of overall economy (i.e. including the cost of the cill) whereas in the U.S.A., the tendency appeared to be in the opposite direction, it being claimed that the cost of the gate is reduced if advantage is taken of three edge support. The American paper gives a mathematical analysis applicable to the design of caissons treated in this way.

With the trend to rectangular lock and dry dock sections, reduction in the cost of the construction of the walls is achieved by use of prefabrication, cellular construction and the use of steel sheet piles.

In a session where the contributions were so varied and weighty, delegates suffered from an "embarras de richesses" and it would be somewhat invidious to select papers for individual mention. Reference will be made to three topics which are of particular interest to the present reviewer. They are the Russian development of a method of structural analysis which rejects the Winkler theory and is based on Russian developments of the elastic theory of Boussineqs and Flamant; the French use of photoelastic techniques in the design of a graving dock in Marseilles and the ingenious method used by German engineers to anchor the floor of a dry dock in Bremen by use of pre-stressed cables attached to sunken anchor plates.

Siltation

Fourteen papers were submitted on the subject of siltation. The Reporter-General was Mr. C. H. Dobbie, B.Sc., M.I.C.E., F.G.S., M.I.W.E., Consulting Engineer, and the contributing countries were Western Germany, Belgium, Spain, U.S.A., France, Great Britain, India, Italy, Japan, Mozambique, Netherlands, Poland, Czechoslovakia and the U.S.S.R.

The full title of the subject was "Siltation in coastal waters, in estuaries, in channels, in tidal basins, in enclosed docks and in maritime canals. Methods of minimising it. Modern methods of measurements of depth, currents, waves, tides and silt movement in coastal waters and in estuaries."

With the current tendency for the draft of vessels to increase, the importance of this subject can hardly be over-emphasised and the papers and discussion bore ample witness to great efforts in research into the mechanism of siltation and of the application of the findings in an attempt to avoid or alleviate its results. In this sphere, as in others, the accurate measurement of natural phenomena both in the prototype and in scale models is a fundamental basis of further work, and the development of measuring instruments and techniques received due prominence. The French paper gave a comprehensive survey of modern methods, and in common with Great Britain, Japan and the Netherlands made mention of the use of radio-active isotopes to trace silt movement. During the discussion a description was given of the use of this

Navigation Congresses—continued

technique in Spain—and it is apparent that the technique is of great potential value in this most difficult field. In Russia a technique has been developed whereby natural sand particles are covered by a very thin layer of luminescent material which emits easily detectable ultra-violet rays.

The use of scale models, now an accepted research weapon, was widely reported. Of great importance is the furtherance of the fundamental research on salt density currents in the U.S.A., reported by an extremely effective and valuable paper.

In the main, however, the papers and verbal contributions described specific problems in many varts of the world and the methods being used to overcome them. This has resulted in a valuable increase in the documentation of a very complex subject and this is one of the primary objects of the Association.

Recognising the need for the exchange of data and research findings, Congress recommended the Executive Committee of the Association to consider the setting up of a Committee to study matters relating to siltation.

The above account of a week of concentrated and serious consideration of important and difficult problems may serve to demonstrate the valuable rôle that P.I.A.N.C. plays in matters affecting shipping and ports. A conspicuous feature of the contributions, both written and verbal, and of the conclusions and recommendations is the realisation of the need for international co-operation in the attempt to control the forces of nature for the good of man. In helping to meet this need, P.I.A.N.C. undoubtedly plays an important part.

Fire Fighting in Oil Ports

By W. A. PARTRIDGE
(formerly Chief Fire Officer, Abadan, Iran)

Since the Second World War the demand for oil has increased enormously and, in an attempt to keep pace with it, the size of tankers has swiftly grown so that today tankers of 42,000, 60,000 and 100,000 tons are being built. In consequence, there are many oil terminals both at home and abroad where major reconstruction work must be carried out before these large tankers can be handled. Jetty berths of up to 1,000-ft. are necessary to accommodate such ships, requiring improved mechanical handling devices, pipetracks, bollards, etc. Also, in most cases, increased pumping facilities and product lines will have to be provided.

The tendency to construct "L" and "T" type jetties for the more recently built oil loading terminals creates greater problems in respect of fire protection and, in the event of fire occurring on a berthed tanker, the resources of the operational and marine staff are tried to the utmost on account of the proximity of other tankers. Of course, fire regulations exist at many of the main oil terminals, in which are clearly defined the specific duties and responsibilities of all officials in the event of fire on a ship alongside or offshore. On such occasions, the utmost co-operation must exist between the Harbour Master, Port Officer, Marine Superintendents, Rivercraft Supervisors and the Officer in Charge of the Fire Service and it must be known to whom belongs the final responsibility.

As far as the responsibilities of all Masters of vessels entering the area of an oil port are concerned, they must be fully cognizant with the regulations of that particular port so that they know what action to take in the event of fire. Safety regulations and pre-

Harbour tug equipped with fire fighting equipment and foam-making appliances.

Foam monitors mounted on towers cover an extensive area of sea and jetty.

cautionary notices are displayed multi-lingually in many ports and facilities are provided to assist ships' officers and crews to comply with the port regulations. In some cases, Masters of ships are served on arrival with several copies of the area or jetty regulations for display on board the vessel. These notices generally define, in detail, the restriction of certain practices in respect of the security of the vessel and the port in general whilst loading or discharge of oil is taking place.

In addition, fire and security port officials regularly inspect oil tankers whilst in port to ensure that the regulations are observed. In point of fact, however, Masters of oil tankers have a keen sense of responsibility and, being familiar with the various port requirements, are generally very co-operative with local security officers.

Steam for cooking, heating, etc. is provided from the shore at certain terminals whilst at others full facilities for food, accommodation and recreation are available ashore to reduce the risk of fire on board.

Fire Fighting Equipment.

In many ports sea-going and harbour tugs are equipped with foam-making and general fire fighting appliances and, in the absence of a fire-float, these vessels play an important part in combating fire on a vessel not moored at a berth. However, three times as many fires occur on vessels in port compared with those at sea and complete reliance should not be placed on the fire fighting facilities available on a tug, especially where an oil tanker is concerned. The whole resources of the tugs may be required to stand by a ship on fire or nearby craft in order that, if it is found necessary, a speedy removal to a place of safety may be effected.

It is now opportune, therefore, that a serious examination should be made of the existing fire fighting facilities ashore so that the best conditions possible may be provided for the mammoth size tankers now envisaged. In many cases, increased water and pumping facilities will be necessary to give adequate overall foam cover-

Fire Fighting in Oil Ports—*continued*

The terrifying spectacle of an oil tanker on fire.

age to a tanker of probably 1,000-ft. in length, with a beam of 125-ft. and 100,000 tons gross tonnage. In view of such dimensions, most existing portable foam equipment would be inadequate, for with an approximate freeboard of 60-ft., it would be extremely improbable that a foam jet operated from the jetty could be directed on to a fire at deck level.

There already exist at many oil ports, including Kwinana, Australia, Aden and Grangemouth, foam monitors mounted on 40-ft. towers which can be operated at platform level or by remote control at the tower base. These have now been in use for several years and were designed to provide efficient and overall coverage for most of the present capacity vessels. However, in view of the larger tankers now building, it has become necessary for certain oil companies to modernise their jetties and oil loading berths, and the fire fighting requirements to meet the increased risks are also under review. It has been estimated that, in order to give sufficient coverage by foam application to any part of a 100,000 ton vessel alongside a jetty, it may be necessary to instal a number of these foam monitors mounted upon 60-ft. high towers to ensure a foam throw across the beam capable of a jet of 200-ft.

Each of these towers would require a supply of 350 g.p.m. of water at 180 p.s.i. at the base and an available supply of Airfoam liquid of approximately 750 gallons for each hour's operation. Foam outlets with accompanying hose sets would be provided at the base of the towers to deal with a fire on the jetty or to run foam lines on to a deck.

As an additional precaution to the facilities provided at the oil ports, the major tanker companies are equipping their vessels with hose and airfoam generating nozzle sets, which are laid out on deck or on the jetty ready for immediate action when the vessel is berthed.

An Electrical Weighing Technique for Crane Loads

By F. R. McKEARS

A revolutionary weighing method which is being widely taken up in industry offers solutions to many of the difficulties encountered in the weighing of bulk cargoes being discharged at a port. Weighing such cargoes is normally undertaken for one or more of three reasons: to check the weights entered on the bill of lading; to prevent overloading of railway wagons, and to provide a basis for the payment of dockside labour.

To weigh each wagon separately on a weighbridge is a time-consuming business, delaying the despatch of trains and necessitating the use of a locomotive for shunting. There is also the disadvantage that the weight is not known until the wagon has been moved from the cranes. If the wagon is then found to be overloaded, it has to be returned to the cranes for correction, involving further shunting and interfering with unloading. Under these circumstances, operators not unnaturally tend to underload the wagons. It has been stated that average wagon loads of mineral ore have been found to be at least two tons below nominal wagon capacity, and the deficiency tends to be greater still with the latest types of ore wagon which, intended to be loaded up to the maximum axle load, are not permitted to travel even if only slightly overloaded.

This troublesome situation can only be avoided completely by locating the weighing operation at the crane itself. From time to time, a number of devices have been suggested which would permit loads to be weighed whilst still in the grab, but for various reasons none of these has found universal acceptance.

The requirements for a crane load weigher are:—

(a) The equipment should require the minimum modification to the crane.
(b) Its use should not involve interference with the normal operation of the crane.
(c) Its economy should be such as to satisfy Board of Trade regulations. This is, of course, a mandatory requirement where the weigher is used as an instrument of sale or where any question of payment (such as that of dockside labour) is involved.
(d) It should embody means of eliminating inaccuracies due to swinging loads.
(e) It should be capable of automatically offsetting the tare weight of lifting cable and grab.
(f) It should not require the employment of a weighman in addition to the crane driver.
(g) Its design should include protection against overload and against deterioration due to exposed working conditions.

Fig. 1.

An interesting method of meeting all these requirements is provided by an electrical weighing system developed by Elliott Brothers (London) Limited. Generally applicable to a wide range of industrial weighing operations, the system has been adapted jointly by its sponsors and Wm. Cory & Son Limited for use on dockside and overhead travelling cranes, and is known as the Elliott-Cory electrical crane load weigher.

Principles of Electrical Weighing.

The Elliott electrical weighing system replaces conventional mechanical balancing methods by the production and measurement of an electric current proportional to the applied load. The basic load-measuring element is the load cell, which consists essentially of a high-tensile steel billet, the slightly-domed top of which can be seen projecting through the top of the diecast case (Fig. 1). When the billet is placed under compressive loading, it undergoes a degree of deformation which, within the elastic limits of the billet material, is proportional to the load.

The linear deflection of the billet under load is measured by means of four accurately-matched cupro-nickel electrical resistance strain gauges which are bonded by a special process to the billet in such positions that two of the gauges (called the "active" pair) receive maximum stress while the other (the "passive" pair) receives either no stress or, alternatively, a stress of opposite sign.

An Electrical Weighing Technique for Crane Loads—continued

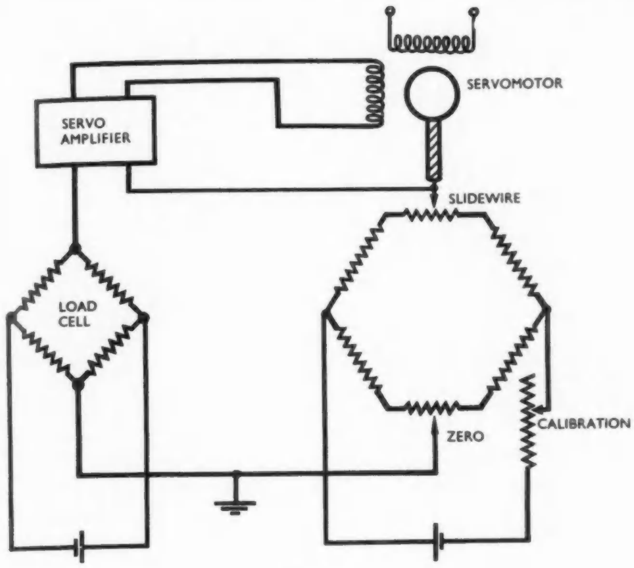


Fig. 2.

The four gauges are connected together in the form of a Wheatstone bridge which, when energised by a low-voltage A.C. or D.C. supply, remains balanced with no output in the absence of a load. When a load is applied, however, the deformation of the billet causes changes in the eletcrical resistance of the strain gauges, with the result that the bridge becomes unbalanced and a small voltage, proportional to the load, appears across its output. On removal of the load, the billet resumes its former shape and the bridge returns to a balanced condition with zero output.

The output signal from the load cell can be indicated or recorded by instruments calibrated directly in units of weight, and can also be made to operate various types of automatic control, print-out and data-processing equipment.

For installation in the crane cabin, a self-balancing bridge indicator which embodies the excitation supply for the load cell is supplied. As will be seen from Fig. 2, which gives the outline circuit for the complete weigher, the voltage derived from the difference between the load cell unbalance signal and the measuring bridge output is amplified and passed to the signal phase of a two-phase servomotor, the reference phase of which is energised from the mains supply. The servomotor drives the sliding contact of a potentiometer in the measuring circuit, and is also geared to the

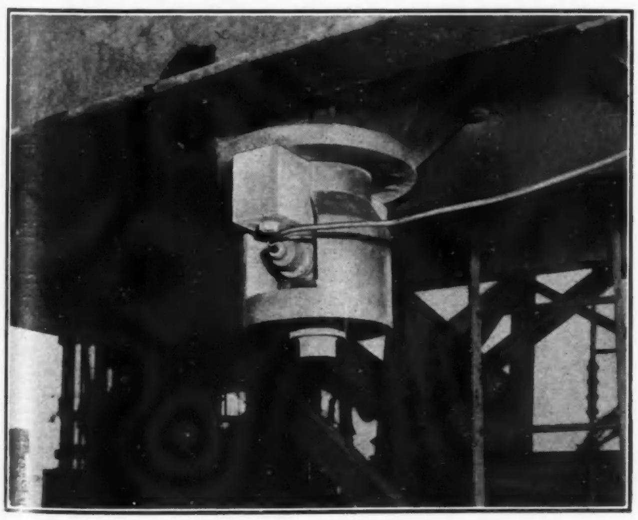


Fig. 4.

indicator pointer. When a load is applied to the load cell, the motor drives the sliding contact to a point where the two unbalance signals cancel out and balance is restored. The position of the sliding contact, and consequently the pointer, is thus proportional to the applied load.

Two further potentiometers are included in the measuring circuit. One controls the electrical zero setting, and is kept locked inside the instrument case to prevent unauthorised tampering. This control is sealed by H.M. Inspectors of Weights and Measures if the weigher is used as an instrument of sale or if any other question of payment is involved. The other potentiometer allows the tare weight of cable and grab to be electrically offset, so that the indications given are true nett weights.

Crane Installations.

The general arrangement for installation on a dockside crane is shown schematically in Fig. 3. The hoist rope is reeved through an extra set of sheaves to which is attached a stirrup assembly carrying the load cell and a thrust block. An actual installation of this type is illustrated in Fig. 4.

Weighing is completely automatic and requires no action on the part of the crane driver, the tension in the hoist rope being mea-

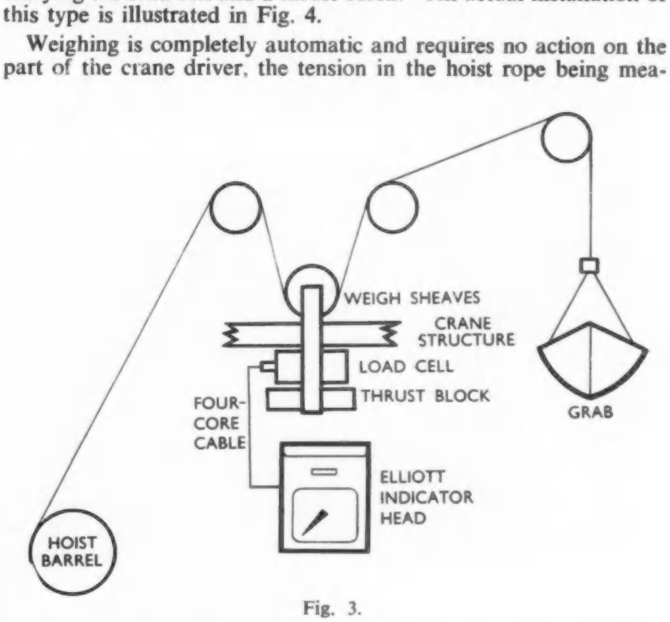


Fig. 3.

sured and indicated immediately the full strain of a lift is taken by the crane. If desired, the indicator head can be fitted with control contacts, operating at maximum safe load and wired into the hoist motor circuit, to prevent overloading of the crane.

The small size of the load cell (approximately 4-in. cube) and the fact that only one 4-core cable is required for connection to the indicatorhead renders initial fitting relatively simple. Adequate protection is provided for the billet by a hermetically-sealed die-cast case which is packed with water-repellent material. The connecting cable may be led through conduit fixed to the crane structure.

In operation, there is no interference with the normal operation of the crane, and the electrical circuit is damped to level out fluctuations of measurement due to swinging loads.

A generally similar arrangement is followed for cranes using hooks instead of grabs, and the weigher can also be fitted to overhead travellers. In the latter case, the load cell is incorporated in the hoist rope anchorage, and the connecting cable is wound on to a spring-loaded cable-reeling drum.

The weigher maintains an accuracy of ± 0.25 per cent. of full scale deflection subject to the age and condition of the crane, and is covered by the Board of Trade Approval Certificate No. 1105 when used for the measurement of bulk materials.

The absence of knife-edges, springs, levers and other mechanical parts reduces the amount of maintenance necessary and eliminates

An Electrical Weighing Technique for Crane Loads—continued

the gradual loss of accuracy associated with wear of such components. Occasional calibration checks can be made without dismantling the equipment.

Two important features are due to the electrical principle of operation. First, the availability of the measured current enables a variety of ancillary equipment to be operated quite automatically, and second, since a simple cable connection only is required, it is relatively easy to install repeater indicators, recorders or other instruments at some remote point, say in the wharf office. It is even possible to arrange V.H.F. radio links to convey measurement data from the crane to the desired location.

Ancillary Equipment.

A recorder using a 10-in. wide roll-type chart may be fitted in the crane cabin as an alternative to the indicator or in the wharf office. The chart record is a continuous ink line consisting of horizontal traces extending from zero to the chart position representing the measured weight and separated from each other by vertical traces at the zero position representing the intervals of time between successive lifts. It is, therefore, an indisputable record of the day's work and is easily analysed for costing and other purposes.

Numerous digital devices have been developed to extend the crane installation into a fully-automatic weighing and accounting system. These devices all depend upon the conversion of the

Fig. 5.

angular position of the indicator shaft into a coded electrical signal. The conversion is made by an Elliott-Giannini shaft digital encoder which is essentially a commutator providing a unique electrical contact pattern for each discrete angular position of the shaft. The measured weight may thus be displayed in digital form on a panel of the type shown in Fig. 5.

The panel illustrated also includes a totalising device which automatically shows the cumulative total weight of the loads lifted during an operation.

A printed record in digital form can be produced by a high-speed electric typewriter which can be made, by means of a patch panel arrangement, to accept and tabulate input signals from a battery of cranes working simultaneously. Such a record can be made to give a completely detailed account of the discharge of a sea-borne cargo, showing the weight of each lift made by each crane, the time at which each lift was made, differentiating between loads discharged into railway wagons, barges or road transport for different consignees, and producing intermediate sub-totals as well as a final total at the end of the whole operation.

Where mechanical or electronic accounting methods are used, card or tape punching machines can be incorporated in the weighing equipment.

The flexibility of the system is such as to enable it to meet the requirements of practically any application, however specialised it may be, and to offer a solution to many of the knotty problems which at present beset operators to whom the weighing of crane loads is of importance.

New Arthur Kill Bridge

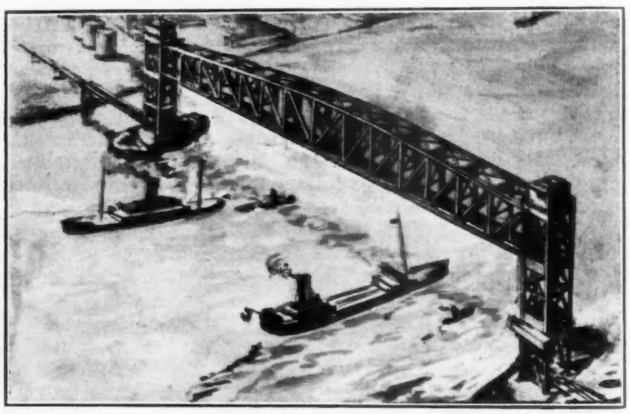
Large Vertical Lift Span

What is claimed to be the world's largest vertical lift span is under construction in the United States and is expected to be completed by 1959. The structure will carry railway tracks over the Arthur Kill channel between Arlington, Staten Island, New York and Elizabeth, New Jersey. Its erection was dictated by the demands of navigation through the channel and was ordered by the Secretary of the U.S. Army.

The lift span will provide a 500-ft. clear navigation channel and, in the open position, a clearance of 135-ft. above mean high water level. It will replace the old bridge which was built in 1888 and provided two navigation openings each approximately 210-ft. wide.

The new bridge will be a single track structure 1,647-ft. long between abutment back walls. A 558-ft. vertical lift span will be flanked at each end by tower spans, 32-ft. centre-to-centre of columns. The eastern approach will have a single, 68-ft. deck plate girder span and the western approach will include one 162-ft. long through plate girder span. Its use in this structure, rather than a through truss span, was selected largely for æsthetic reasons.

The substructure for the bridge will consist of the two main piers with fender systems for the vertical lift span, 11 approach piers and two abutments. All piers are carried to rock and the two abutments are supported on concrete piles.



Artist's impression of the world's largest vertical lift span.

Approximately 4,750 tons of steel will be required for the new structure. Of this, some 700 tons of carbon steel will be used in the approach girder spans and 4,050 tons of carbon and alloy steel in the lift span and towers.

The lift span, weighing approximately 2,000 tons, will be connected to balancing counterweights by 80 wire ropes, $2\frac{1}{4}$-in. in diameter, passing over eight roller-bearinged sheaves 15-ft. in diameter. A maximum load of about 280 tons is anticipated at each bearing. The span will be operated by electrical motors located at the top of each tower. Two complete drive systems will be provided, with the principal source of power on the New Jersey side of the river. Provision is made for emergency power supply.

Normal travel of the span will be 104-ft. and the time required for opening full height, or for closing, will be $1\frac{1}{2}$ minutes.

The bridge will be equipped with aviation warning beacons, navigation lights and an audible navigation signal, in conformity with the requirements of the Civil Aeronautics Administration and the United States Coast Guard.

The new bridge is being constructed with the least possible interference to railroad traffic and navigation in the Arthur Kill Channel, but during erection of the vertical lift span, the channel will be closed.

The bridge was designed by Parsons, Brinckerhoff, Hall and MacDonald. The substructure and superstructure of the approaches were designed by the Engineering Department of the Baltimore and Ohio Railroad. Field work is under the jurisdiction of C. L. Kroll, regional engineer.

The Port of Oamaru, New Zealand

Development of a Dominion Harbour

(Specially Contributed)

Oamaru, the second largest town in the Province of Otago, New Zealand, is strategically placed in the South Island's communications network. It lies on the main trunk railway system, and daily road transport services link the town with the metropolitan centres of Dunedin, the capital of Otago and Christchurch; there is also a first class airport at Hilderthorpe nearby. The port of Oamaru has a good harbour which is in regular use by coastal and ocean-going vessels, and there is an easily accessible roadstead, sheltered in the lee of Cape Wanbrow. Backed by a fertile, well-farmed hinterland, much of the town's present prosperity is due to the primary resources of North Otago, but at the same time secondary industries and modern commercial undertakings are making a substantial and growing contribution.

The beginnings of the township date from about 1843 when a small settlement of the whaling fleet personnel was established at the head of the bay. A natural development was the building of jetties and landing or loading places along the shore in the high flanks of Cape Wanbrow. By 1880 Oamaru had grown into an important centre for marketing and shipping for the agricultural pioneers of the district.

It is appropriate here to mention that the first carcases of frozen mutton exported from New Zealand came from a farming settlement near Oamaru in 1881. The daily output then was 240; to-day it is no less than 6,000 in the killing season at the new Pukeuri Freezing Works on the main railway just north of Oamaru.

However, since the lean years of the 1930's, when trade depression seriously affected the world's markets and exposed the vulnerability of an economy dependent almost solely on agricultural products, every endeavour has been made to ensure a more stable economy. This takes the form of extensive and varied manufactures of finished goods and Oamaru has taken its full share of this activity.

In the industrial sphere, Oamaru is fortunate in two respects. It is near the main source of the South Island's electric power supply at Waitaki and it has a good harbour. However, although last year the foreign-going and coastal trade surpassed the pre-war figures, overseas shipowners have continued a war-time policy of centralisation of shipping, much to the disadvantage of Oamaru. The Harbour Board, the North Otago Progress League (representing the commercial interests) and the Farmers organisations of the district have all made strong pleas for the restoration of this shipping but, so far, little has been achieved. Nevertheless, the Harbour Board are carrying out an extensive modernisation programme, which includes the improvement of the approach channels by dredging and deflection moles; the reconstruction of the wharf decks and the provision of mechanical equipment to meet modern requirements.

The swinging basin lies within the harbour entrance between the Holmes and the Sumpter wharves (see Fig. 1) and is able to accommodate vessels of up to 520-ft. in length. The Holmes wharf, chiefly used by such ocean-going vessels as the "Coptic," 8,913 tons, and the "Otaio," 10,298 tons, has a low water depth of 26-ft. There are two other wharves, the Normanby and the Macandrew. At the time of writing, the latter is not in use due to siltation, to which further reference will be made later.

Rail tracks run the full length of all the wharves and the quays

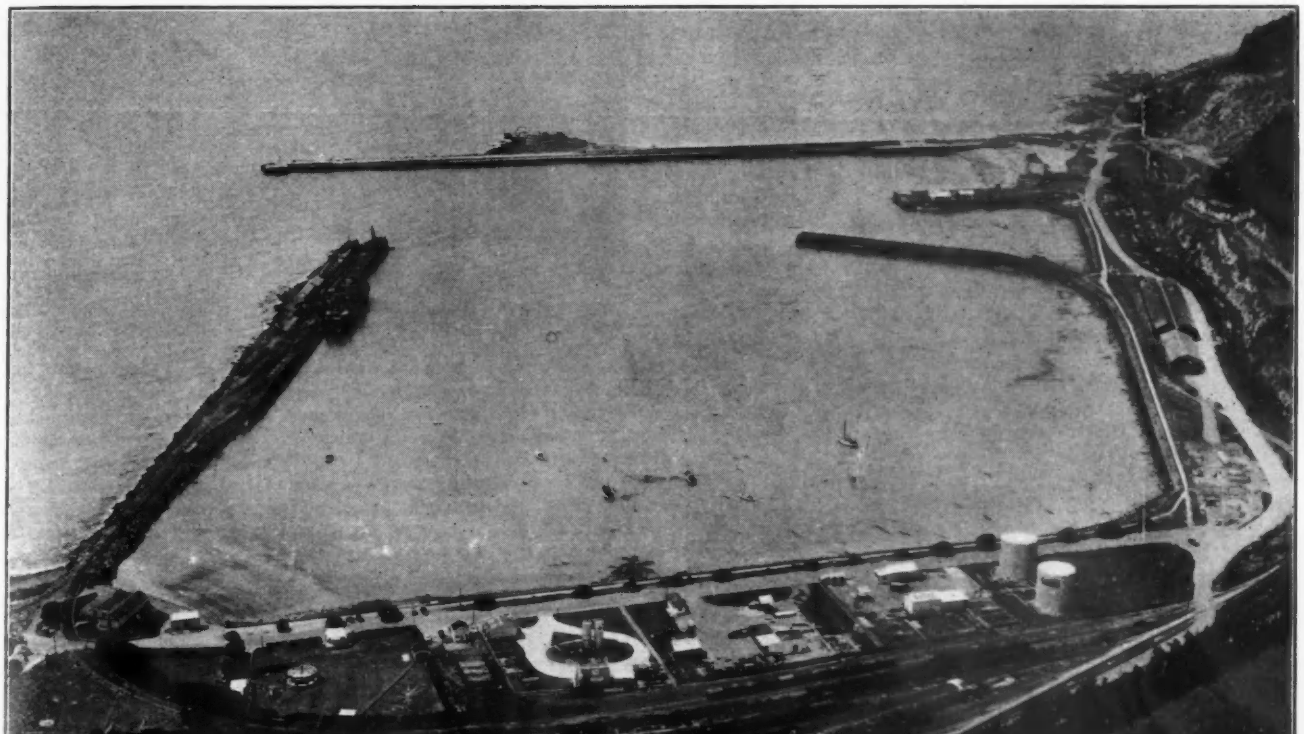


Fig. 1. Aerial view of Oamaru harbour. In the foreground, New Shell oil depot, sidings, sheds and offices. To the left, Holmes Wharf; to the right, Sumpter Wharf: in the background, the East breakwater and the Ramsay spur extension

The Port of Oamaru, New Zealand—continued

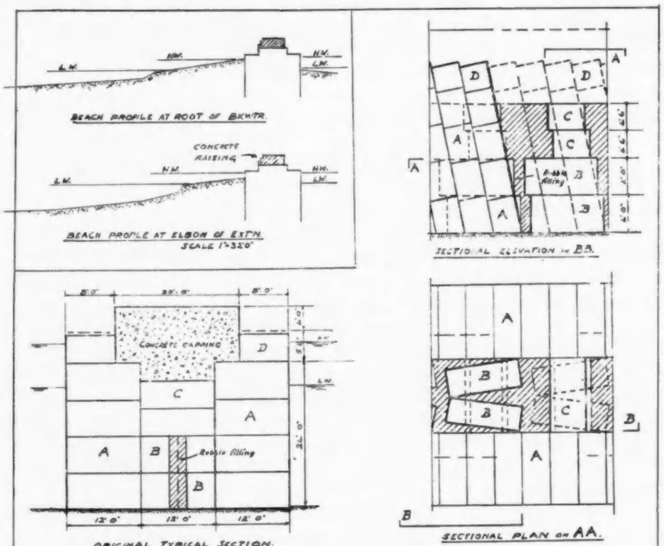


Fig. 2. Detail of the original breakwater showing the construction of sloping blocks (A and D) built in 1883-87; note the unusual core fill: hatching denotes rubble. Inset—profile of beach at present time showing the great accretion on sea face of wall. The additional 7-ft. heightening of wall shown hatched: rubble apron on sea flank omitted.

are adequately supplied with electric lighting and power. Where possible, full use is made of a ship's derricks or cranes on the American principle; there are no quayside cranes but if required, the Harbour Board's mobile cranes of up to 20 tons capacity are available.

HARBOUR CONSTRUCTION WORKS

The present day harbour covers 60 acres of protected water, and the swinging basin is sufficiently large to accommodate ships up to 520-ft. in length and a tonnage of 10,500 tons. It is adequately protected against the zones of greatest fetch and predominant southern and eastern seas—the rough weather quarters on this coast.

The harbour area is enclosed (Fig. 1) in the south-west elbow of the bay by two breakwaters, the main concrete wall on the east and a rubble wall on the north. The main wall is aligned almost

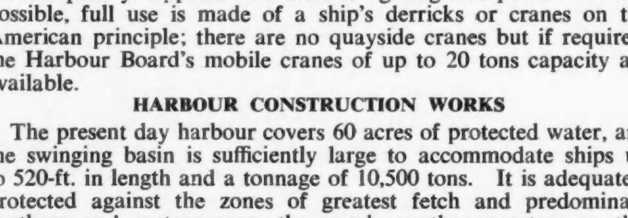


Fig. 3. Main breakwater, moderate sea at high tide. Note the sand beach height close to the elbow of the spur called Ramsay extension, also the spill of the rubble over the breakwater after the dying E.S.E. storm (see Fig. 4).

north and south and is rooted at the south in the rocky bluff of Cape Wanbrow. It is 1,850-ft. in length, 56-ft. wide at the root including the deck of the Macandrew Wharf, and from here to the entrance head it is 36-ft. wide. It is of unusual construction and differs widely from modern practice but, in view of the fact that it has survived for nearly 80 years, some details are worth noting. It is highly probable that the success achieved by Messrs. Telford and Gibbs in the construction of several breakwaters with sloping-blocks in Scotland (1820-1850) notably at Ardrossan, Aberdeen and Peterhead, influenced the choice. At that time the main advantages of the design were rapidity of construction, the short length of scar end, the ease of preparing foundation bedding and the ease of deck finishing with a mass concrete capping to seal and to cover any irregularities in the surface block ends.

The Oamaru wall design was no doubt conceived as an improvement on the Scottish practice for the conditions of the site and the resources available. Briefly the construction (Fig. 2) comprised two parallel face walls (sea and harbour sides) built up of 12-ft. x 6-ft. x 4.5-ft. plain concrete blocks (20 tons) coursed on a slope and 12-ft. apart. The blocks A were plain parallelopipeds of concrete without tongues or grooves, dowel holes or shear pins, and were all headers, coursed with the 6-ft. width on a slope making 78 degrees with the horizontal (5 : 1 batter). Since the breakwater was 36-ft. wide there was a gap of 12-ft. between the two

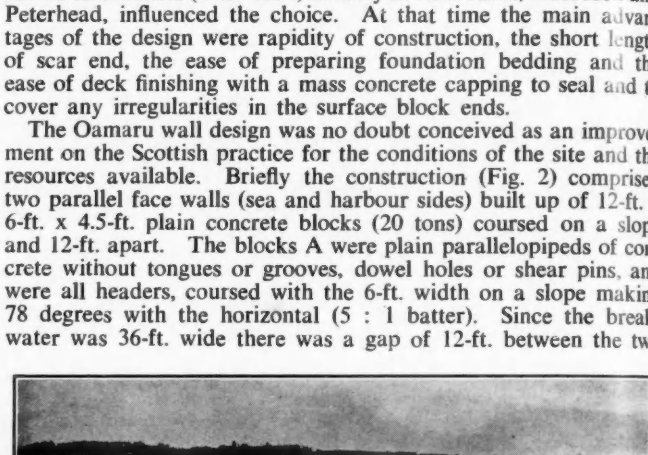


Fig. 4. Rubble tipped near the root of the wall to prevent the overtopping of the violent send from south east gales. Photograph taken before peak period (see Fig. 3). The North breakwater (Holmes Wharf), entrance head shows at top left.

face walls, which was filled with blocks B and C and rubble fill. In the lower courses groups of twin blocks, as shown in plan were placed in the form of a horizontal V and each succeeding higher course was offset over the lower so that the forward bottom edges coincided with the line of batter of the outer block faces A. In the upper courses single blocks C were placed transversely in the manner shown: these were also offset and laid flat over the blocks B. The hatched spaces were then back-filled with rubble. Mass concrete capping was then poured over the tops of the blocks and rubble as shown.

One is forced to the conclusion that this unusual core construction was devised as a measure of economy and for the security of the scar ends during the building period; (a) had the breakwater wall been entirely of sloping-blocks the centre portion would have required twelve in number whereas with the above design only six were used which represents 50 per cent. saving for the portion and 16 per cent. for the full width minus the cost of rubble; (b) regarding the manner of placing of the blocks in the centre it is to be noted that for every length of three sloping courses of face blocks, the centre blocks B, and C, and the mass concrete capping provide resistance to shear and sliding; (c) it is also to be noted that for sloping-block construction the blocks are on the light side, due, no doubt, to the capacity limit of the construction plant and the inexperience of the local labour force. All the blocks used were 12-ft. 6-in. x 4.5-ft. with the exception of the deck level face blocks which were 8-ft. x 4-ft. x 4.5-ft., between which the mass concrete of the capping was poured.

The Port of Oamaru, New Zealand—continued

On completion of the wall construction, the seaward face was protected by a substantial pell mell wavebreaker apron of concrete and natural boulders up to 20 tons weight in the dry. This was found costly to maintain. During storms from the south west the boulders were sucked down into the loose sand bed. For many years the general make-up has averaged 2,500 tons annually. The local stone used, quarried in the flanks of Cape Wanbrow was found to fracture and disintegrate rapidly and the smaller material picked up in the wave strokes wrought heavy damage on the wall face and the concrete capping.

The Ramsay Extension.

The predominant gale quarter lies in the south-east sector and the next in order of wind strength is from the north-north-east. Although the latter is not of frequent occurrence, it has the disadvantage of blowing more or less parallel with the line of Leading Lights of the harbour entrance. The fetch to the S.E. is a maximum (900 nautical miles plus) but that of the N.E. is only a few miles. It will therefore be appreciated that with the breakwater aligned south to north the wave impact from the south east will be reflected in a north east direction, hence the resultant of both, impact and reflection, parallel to the face of the wall will have a common direction from the root to the entrance head: a relative direction whilst not unique is not common. As a consequence the sea-bed drift of the material is towards the deep water of the approach channel.

As already stated the main breakwater (Fig. 3) when completed in 1886-7 was, at low water, in 20-ft. depth of water for the greater part of its length but since that time there has been progressive accretion of sand and shingle against the wall face.

In this connection, it is as well to recall that in the nineteenth century in all parts of the world little or no consideration was given to the effect that construction works would have upon the littoral drift around a site. The breakwater of Oamaru was no exception. Thus it transpired that in the 1930's a difficult problem had to be faced by the Harbour Board engineers. Alongside the wall for about 1,000-ft. from the root, the low water depth had been reduced to zero and the sand was creeping into the approach channel necessitating constant and heavy dredging. In addition to this, a great quantity of sand, shingle and small boulders was projected into the harbour by the overtopping waters.

However in 1935 when trade returns were substantial the Government of New Zealand subsidised the construction of a spur wall, rooted in the main wall at about 1,000-ft. from the shore (see Figs. 1, 2, 3 and 4). This spur wall became known as the Ramsay extension and its purpose was to limit the forward travel of sand drift and to deflect the waves and the drift away from the entrance head. At the same time it was decided to raise the height of the breakwater by 7-ft. to prevent the spill of water and material into the harbour which threatened to limit the use of the Macandrew wharf. Although the spur was intended to be 500-ft. long, construction was discontinued when only 300-ft. had been completed, on instructions from the Government and the withdrawal of the

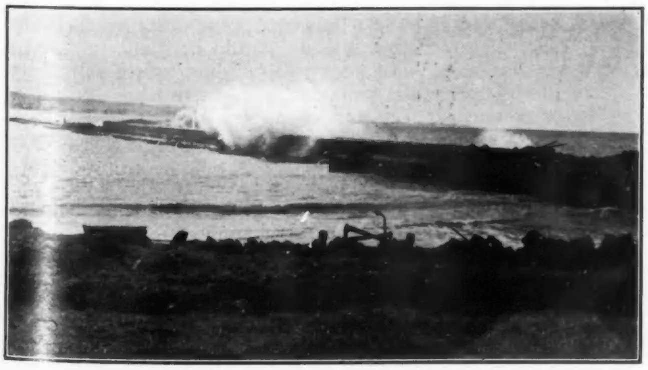


Fig. 5. E.S.E. gale at high tide, showing overtopping and damage to rail track over the rubble. The 7-ft. high raising above the wall capping shows up clearly.

Fig. 6. The Ramsay extension spur, showing damage to the massive concrete wall due to the scour of the seabed and the slumping of the scar end. Cape Wanbrow in the background.

subsidy. This change of plan resulted from rumours of war and the adoption of the policy of Shipping Centralisation.

Despite the alleviation obtained from the incomplete Ramsay extension, the dredging programme remained formidable. The Harbour Board had disposed of their own dredger and were therefore forced to hire one from a neighbouring port. This, however, did not interfere with the construction of the additional 7-ft. of height to the wall above the concrete capping, CR and M respectively in Figs. 2 and 5. This was completed as planned; the rubble apron from the spur to the shore was also remade.

The type of construction of the spur comprised a tipped rubble core on the seabed blanketed on the slopes with natural quarry stones of up to 20 tons dry weight. The crown was 25-30-ft. wide and 15-ft. above high water. The slopes were $1\frac{1}{2}$ to 1 below low water and 2 to 1 above, on the south-east face; and rather steeper on the north-west face. During construction the scar end suffered a great deal from scour of the sandy bottom, in bad weather, causing considerable slumping of the crown. This happened so often that it was eventually decided to seal the stones in place by pouring concrete. As a further reinforcement it was also decided to construct a massive concrete wall along the crown instead of again building up with stones. Fig. 6 shows this construction and represents the condition at the time of writing. Since the original work was completed, however, the large stones on the slope have disintegrated and the smaller boulders resulting have been catapulted by the waves to the lee, over the concrete wall and now rest in the acute angle space between the spur and the main wall. In this manner the angular space has been filled with boulders as may be noted from the photograph.

Present State of Harbour Works.

The discontinuance of full maintenance during war years and for some time after gave anxiety to the Harbour Board and their engineers. Inadequate income and lack of subsidies made it impossible to carry out the comparatively heavy programme of works required, and in addition, first priority dredging, already a heavy burden, together with urgent repair of wharf faces and decking absorbed all available resources.

Meantime the East Breakwater and the Ramsay spur were deteriorating, particularly in the elbow of the junction of the main wall and the sea end of the spur (see Figs. 5 and 6). The consulting engineers were averse to further outlay on tipping rubble which despite the constant replenishment did not last effectively for long. It was also considered that the usefulness of the spur had passed its peak and would be ineffective further. To cope with the present conditions, therefore, the engineers have decided to construct a wavebreaker mole of Tetrapods between the spur and the root of the main wall.

Cargo Handling and Marking

I.C.H.C.A. Conference at Hamburg

The Third Technical Conference of the International Cargo Handling Co-ordination Association took place in Hamburg early in July and was attended by more than three hundred delegates from the principal maritime countries of the world. The two previous conferences were held respectively in Rotterdam and Naples.

At Hamburg the technical session was divided into a series of four symposia:—

No. 1 dealing with problems of handling cargo on board;

No. 2 with the marking of cargo;

No. 3 with the employment of containers and the unit load system; and

No. 4 with the handling of fresh fruit.

Symposium No. 1. Handling on Board Ship.

A synthesis of this subject was presented by the French National Committee of I.C.H.C.A., who dealt with the subject under three headings, viz.: (1) handling on board vessels of conventional construction; (2) the provisions made by certain shipowners for the purpose of facilitating and speeding up loading and unloading operations; and (3) specialised vessels.

Of the supporting papers, that by Mr. John R. Sharp of the United Kingdom was one of the more interesting. Mr. Sharp discussed ship design and construction and also the kinds of improvements it would be useful to make to warehouses and wharves. He then went on to deal with the application, use and standardisation of handling equipment, finishing his paper by suggesting that port operating work is insufficiently mechanised because (1) equipment has to be adapted for port use, since it has not been designed for that purpose and (2) there is very little suitable equipment so far available. He did not, however, mention a third and most important reason why port work cannot be mechanised in a planned manner, like factory work. It is that there are no standard working conditions, even at one berth (unless it is a specialised one). Import and export cargoes in most ports of the world vary over a wide range of commodities and in the size, shape, weight and pack of individual packages, so that gangs of men handling them must frequently change their methods, gear and equipment, sometimes as often as from hour to hour.

In the general discussion on cargo handling, Rear Admiral E. G. Fullinwider (director of the Maritime Cargo Transportation Conference of the U.S. National Academy of Sciences) described the results of a survey carried out on board the s.s. "Warrior" and also mentioned the "roll-on, roll-off" type of cargo vessel now being experimented with in his country. (The M.C.T.C.'s study "the s.s. Warrior" was reviewed in our issue of June, 1955; the "Roll-on, roll-off" study in our July, 1956, issue).

Also during the discussion, the controversial subject of ship's gear versus quay cranes inevitably arose. An important factor in this matter is that most U.S. ports were not originally constructed to take the weight of modern quay cranes and, in the majority of cases, have not the width of apron; thus the national policy is to make the ships themselves self-sufficient to the greatest extent possible.

Symposium No. 2. Marking of Cargo.

The synthesis on this subject was presented by the United Kingdom Committee, who made the point that an important factor in the quick turn-round of ships is the quick identification of goods on arrival at destination. "The subject of cargo marking," the paper states, "is closely linked with methods of packaging, even in general cargoes of cased or bagged goods; while in the case of bundled goods such as steel rods, tubes, tyres, etc., complex problems arise.

While certain marks are necessary from the point of view of the handler and carrier of the goods, others are equally necessary for the importer; but in many cases these latter would appear to be unnecessarily complex and are frequently concealed under a mass of material of doubtful value; as a result, slow outturn, increased handling costs, pilferage and avoidable insurance claims are the order of the day all over the world, bringing about a major contribution to rising costs of living.

A detailed study carried out jointly by handlers and importers in a spirit of goodwill and co-operation is the sole means of bringing about an improvement in a condition which passing years have tended to aggravate rather than improve."

In a supporting paper, Mr. O. Kramer of Hamburg, stated that, with regard to the marking of meat from South America, some such steps as recommended above had already been taken. Recommendations made by Hamburg port interests have been distributed to import firms, who have in return sent them to their shippers. The shippers have agreed to consider the proposals, which are, briefly (1) that markings should be put on in such a way that (a) any worker can read them day and night and under artificial light, (b) the package need not be turned over (i.e. it should be marked on both sides), and (c) each packer employs a different colour; and (2) that on the wrappings there should be no stencilling but only certain listed brush-marked signs 4—5 cms. thick.

There is no doubt that the marking of cargo would receive better attention if stevedoring and other organisations handling goods through ports would take their difficulties to the shipping company concerned more frequently.

Symposium No. 3. "Containerisation" and Unit Loading.

This was prepared by the United States Committee. Mr. O. D. Colvin (New York) referred to the Pan-Atlantic Steamship Corporation tankers which carry 20-ton containers on deck and stated that a special study had shown that one-quarter of all general import cargo and one-third of export cargo which passes through the port of New York could be carried in containers. Mr. Michael K. Bustard (Atlantic Steam Navigation Co. Ltd.—Transport Ferry Service) said that the average make up of a typical ferry cargo might consist of 15 lorries (with their drivers), 45 trailers and 20 containers. The latest type of transport ferry would carry 90 unit loads containing about 500 tons of merchandise. "It may well be," he declared, "that in the short sea trades, the time will come in the next two or three decades when for general cargo purposes, the conventional cargo ship will be regarded as "horse and buggy" transport—antique, slow and uneconomic. For bulk cargo purposes, the bulk carrier will remain pre-eminent but the general cargo liner services on the short sea routes on high in-port time, particularly the overnight services, will be entirely vulnerable to container-and-trailership competition. Sooner or later, the operators of these soon-to-be-outdated ships will have to choose between switching over to unit load design or going out of business."

Symposium No. 4. Handling of Fruit.

A report of fruit and produce handling was submitted by the Spanish National Committee. It reviewed the methods in use at Valencia, where, the Committee thought, palletisation and the use of fork-lift trucks seem desirable for handling cases of oranges; and the use of side doors in ships is practicable, as there is little variation in tide: In the Canary Islands, however, the use of side ports is not recommended owing to the great variation in tides. In this trade, large hatches are deemed essential and loading by ship's winches satisfactory.

The Italian Committee also presented some observations on this subject. They suggested that a study should be made to ascertain (a) future traffic needs, with a view to building up specialised ship and shore installations, (b) the most appropriate types and dimensions for containers for fruit and vegetables, and (c) possible modifications to packaging in relation to the carrying of this cargo in containers.

A representation of the Inland Waterways Division of the British Transport Commission explored in a paper the idea of containers which would be amphibious and made suggestions for the design of a 15-ton "floating box." Other speakers gave examples of ship-time saved by the introduction of pallet and container methods.

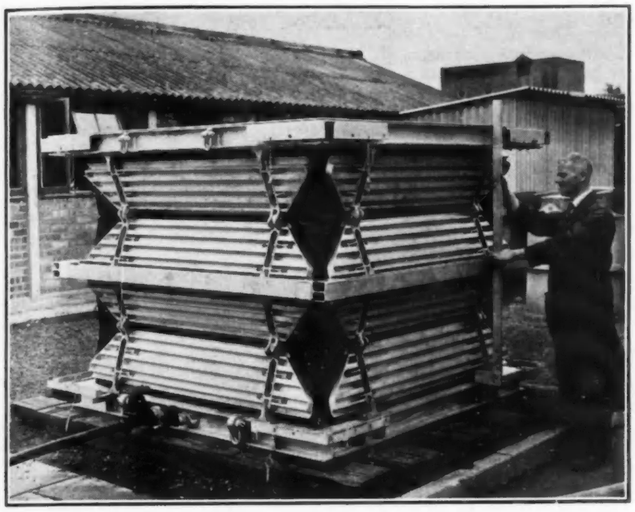
During the four days of the meeting delegates had the opportunity to visit the Mechanical Handling Exhibition in Hamburg, to make a water trip round the port and also to visit certain port installations of special interest. There is no doubt that the exchange of information and views outside the conference room was a very useful supplement to the whole proceedings.

Manufacturers' Announcements

Collapsible Tanks for Bulk Transport

Collapsible tanks of 850-gallons capacity are being developed by Marston Excelsior, Ltd., of Wolverhampton, for R. & H. Green and Silley Weir, Ltd., for transport of smaller parcels of bulk fluid when it is necessary for the load to be transferred from road to rail vehicles and possibly to be loaded on to barge or ship during the course of the journey.

To enable these operations to be carried out the total weight of tank and payload must be less than the smallest capacity lifting



Collapsible tank in process of being raised to maximum height.

equipment normally encountered during the course of a journey. Suitable lifting equipment is usually available at loading bays of road and rail transport organisations and whilst gear capable of lifting loads up to 25 or 30 tons is found on most sea-going vessels this, however, is limited to certain holds only. Since these tanks are suitable for stowage in all cargo spaces of vessels where only the normal derricks are available, their total loaded weight is therefore limited to just under 5 tons. In arriving at this weight, consideration was given to the circumstances at remote ports where off-shore discharging into lighters is the only possible means of getting cargo ashore—also at small ports where no crane facilities exist and the ship's gear has to be used.

The tanks described above are suitable for consignments loaded by the producer which are not discharged until arrival at the consumer's premises. This method of carriage will, it is considered, lend itself well to Customs requirements, since the cargo can be sealed to meet all demands.

When being returned empty these tanks will possibly be subject to top-loading with dry merchandise, and since they will be stowed either in 'tween-deck or on deck they have been designed to carry a top-loading of up to 300 lbs. per square foot.

In instances where road and rail haulage contractors wish to employ collapsible tanks on their vehicles so that alternative loads of liquid and dry cargo may be undertaken, the tanks are fitted directly to the vehicles, the payload being pumped or allowed to gravitate to and from the tanks. The maximum top deck loading in these instances will be limited to the maximum payload weight for which the vehicle has been built less the tare of the tank. This will, of course, be less than that of the tank described above and in the majority of cases will not exceed 150 lbs. per square foot.

Both of the tanks described have the same features as the 2,900-gallon capacity Marine-type, including cargo loading and discharging connections, venting connections and ample manhole for cleaning and inspection. They can, if required, be fitted with temperature control units (steam or electrical).

The dimensions of both types of 850-gallon capacity tanks are:
Height when empty: 6-ft. 9½-in. x 6-ft. 9½-in. x 1-ft. 10-in.
Height when loaded: 6-ft. 9½-in. x 6-ft. 9½-in. x 5-ft. 0¾-in.
Weight: The "lift-on lift-off" container type capable of carrying 'tween-deck dry cargo when empty, 19 cwt., whilst the vehicle type will be somewhat less.
The inner linings suitable for all mineral oils, petroleum products, chemicals, etc., are manufactured of 4-ply fabric/synthetic rubber, and for edible oils, wines, etc., there is an additional special barrier lining designed to avoid taint and contamination of contents.

All types of collapsible tanks are suitable for carrying all mineral oils from crude oil to petroleum products, edible and non-edible oils and many chemicals. Tests are at present being carried out for wine, beer, milk, etc., by the laboratories of the industries concerned.

Adjustable Cable Assembly

A new type of cable lashing was announced recently by the distributors Messrs. Furness Withy and Co. Ltd. (Stevedoring Dept.). It is known as the P. and H. Rapid Adjustable Cable Assembly and it is a combination of two complementary devices. One component consists of a galvanised steel wire rope strop or bridle on which are threaded loose "beads" or lengths of steel tube. The beads form a means of adjusting the wire to a desired length by the insertion of the rope into a slot in the end of the second component, the tensioner.

No pinching or gripping stress of any kind is applied to the wire. The strain imposed is entirely distributed throughout the whole length of the beaded wire rope, being transmitted from the tensioner, through the beads, to the swaged end.

The equipment is claimed to possess a number of advantages over the common forms of lashing making use of ropes and chains. It is manufactured of weather-proof material and will not stretch or rot, therefore the deterioration factor is almost negligible. It displaces chain lashing and is said to be much stronger when compared weight for weight. When set, the tensioner is vibration proof so cannot "walk back," thus maintaining an even and constant tension until released. Loads can be made safe against pilferage by the expedient of inserting a padlock in the locking bar of the tensioner.

Container secured by new cable lashing. Note the tension on the wire and the lightness of the equipment compared with the heavy chain commonly used

The Assembly is available in four sizes, Types A, B, C and D and is capable of resisting working strains that range from 5/6 cwts. for Type A, to approximately 3 tons, depending on the kind of connection in use, for Type D.

Conversion of Tanker to Grab Dredger

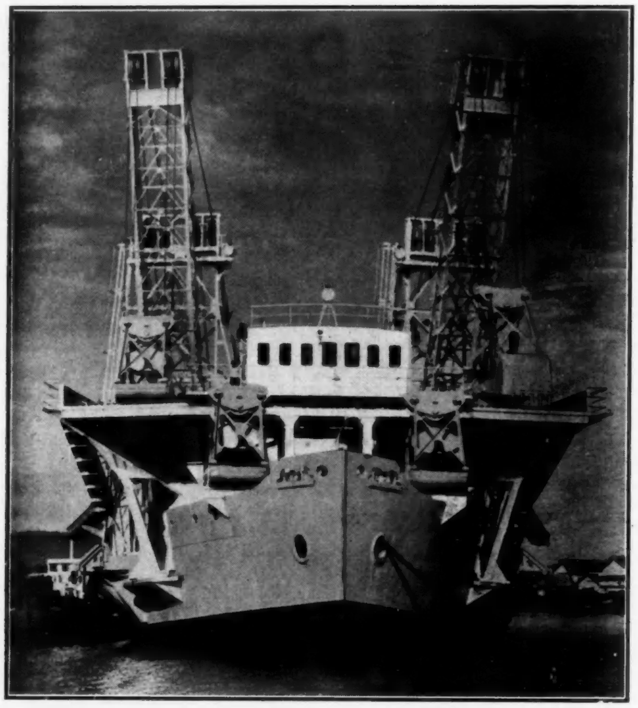
A new type of tin dredge, which will be employed on tin bearing properties in the open sea off the West Coast of Siam, has just been completed.

The dredge, the "Pibul," was originally built as an oil tanker and as the design lent itself to the layout of a grab tin dredge it

Manufacturers' Announcements—continued

was purchased for that purpose. The conversion work, which consisted of the removal of some 450 tons of machinery and steelwork from the original hull, was carried out under the supervision of the Consultants, Messrs. Priestman Brothers Limited, working in co-operation with the Chief Engineer of Aokam Tin Ltd., the owners.

The work, which took approximately two years to complete, was carried out whilst the vessel lay at moorings in the Prai River, near Butterworth, Malaya, and has resulted in the vessel being completely changed in appearance. The original diesel driven twin screw machinery was removed and in its place was fitted three diesel alternators to provide power throughout the vessel for all purposes. In the same compartment twin screw A.C. electric propulsion motors are fitted together with the associated distribution boards, control gear and other auxiliary equipment.



The "Pibul" after completion of conversion work.

Two Priestman 4 yd. Deep Grabbers were fitted forward on a specially constructed false deck structure overhanging the sides of the vessel. The two dredging units are of the level luffing type and each handle a 4 cu. yd. Priestman Heavyweight Grab of the four rope type at depths down to 220-ft. below water level. The total load of grab and contents is 15 tons and the hoisting speed is 400-ft. per minute. The maximum outreach is 40-ft. and the minimum for discharging purposes is 20-ft.

The winch mechanism for each dredging unit consists of a Ward Leonard motor generating set controlling two hoisting and holding motors which drive the winch mechanism. With this control system complete speed control can be obtained.

The operators of the two units are stationed in the pilot house, one at each side of the vessel. Through the side windows they have a full view of their work.

At 100-ft. depth below water level it is anticipated that the output per dredging unit will be in the region of 200 cu. yds. per hour. Once the material has left the grab it passes through grizzley bars into feed hoppers from which it is removed by means of a plate type feeder, one of which is placed at each side of the vessel and which delivers the material to a central elevating conveyor to raise it onto the mouth of the revolving screen.

From the revolving screen the material is discharged into a specially designed distribution box which leads it into the jigs placed on either side of the vessel. After a final cleaning and washing process the tin ore is bagged on board the vessel and stored in a special compartment.

APPOINTMENTS VACANT

FEDERATION OF MALAYA

Civil Engineers are required by the Malayan Railway Administration as Resident Engineers for employment on construction and/or design of new port works and also on general railway engineering work.

Appointment on contract/gratuity terms for 3 years in first instance.

Senior Resident Engineer.

Candidates must be Chartered Civil Engineers and have had not less than 10 years experience in heavy engineering, preferably on port construction.

Gross emoluments:

Single men	£2268 p.a.
Married men without children ...	£2618 p.a.
Married men with children	£2849 p.a.

Resident Engineers.

Candidates must be Chartered Civil Engineers or possess a University degree or diploma recognised by the Institution of Civil Engineers as granting exemption from Final Parts I and II of the A.M.I.C.E. examination plus 2 years practical experience.

Gross emoluments according to age, qualifications and experience in scale:

Single men	£1218—£2120 p.a.
Married men without children ...	£1440—£2499 p.a.
Married men with children	£1531—£2730 p.a.

For candidates with experience in excess of the minimum quoted above higher commencing salaries can be offered, e.g. a candidate with a degree and 12 years post graduate experience would be eligible for gross emoluments as follows:

Single men	£1687 p.a.
Married men without children ...	£2050 p.a.
Married men with children	£2253 p.a.

On satisfactory completion of contract a gratuity at the rate of £232 or £324 p.a., according to salary, would be payable.

Free passages. Free medical attention. Generous home leave. Low Income Tax.

Apply—Director of Recruitment, Colonial Office, London, S.W.1. Give details of age, qualifications and experience. Quote BCD 110/23/04-05/D.23.

NIGERIAN PORTS AUTHORITY has vacancies for TRAFFIC OFFICER INSTRUCTORS. Men of matured experience aged 45 or above or with at least twenty years practical experience in quay/shed work in a large scale port organisation.

Applicants must be of a keen and energetic disposition and have requisite capacity and temperament for training Nigerian staff. Knowledge of all aspects of cargo handling essential including some years practical and supervisory experience in shed/quay work, customs and other documentary procedures and the use of mechanical handling equipment.

Successful candidates will be appointed on a contract basis for two or three tours. Salary will be £2,000 per annum consolidated with elegibility for a gratuity at the end of the period of service.

Tours normally 12-15 months. Leave on basis of seven days for every completed month of service. Free first-class passages for officer and wife. Additional passages and allowance for children. Furnished accommodation at reasonable rental. Car allowance and free medical attention.

Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M3B/43712/DU.

CIVIL ENGINEERING DESIGNERS required by Westminster Consulting Engineers with experience in the design of one or more of the following—Harbour and dock works, bridges, large dams, reinforced concrete and mass concrete structures. Salary according to experience. Five day week. Pension Scheme. Luncheon Vouchers. Apply stating age and experience to Box No. 198, "The Dock and Harbour Authority," 19, Harcourt Street, London, W.1.

WANTED

WANTED—DOCK AND HARBOUR AUTHORITY, August 1954. Phiebig, Box 352, White Plains, N.Y., U.S.A.